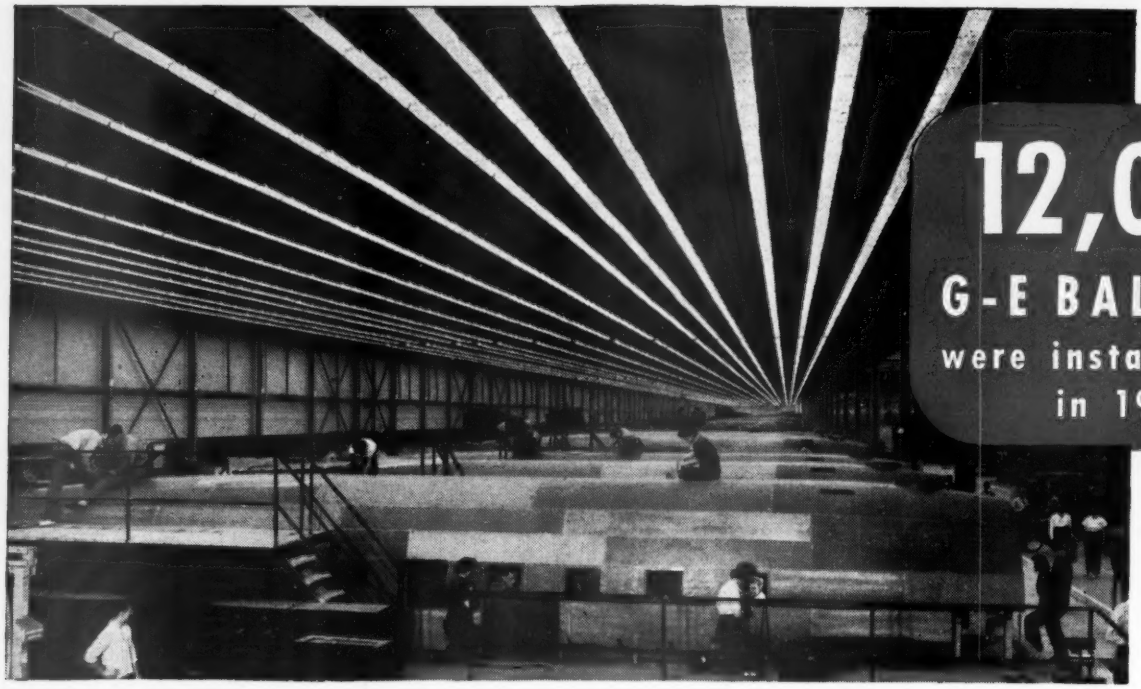
Electrical Contracting

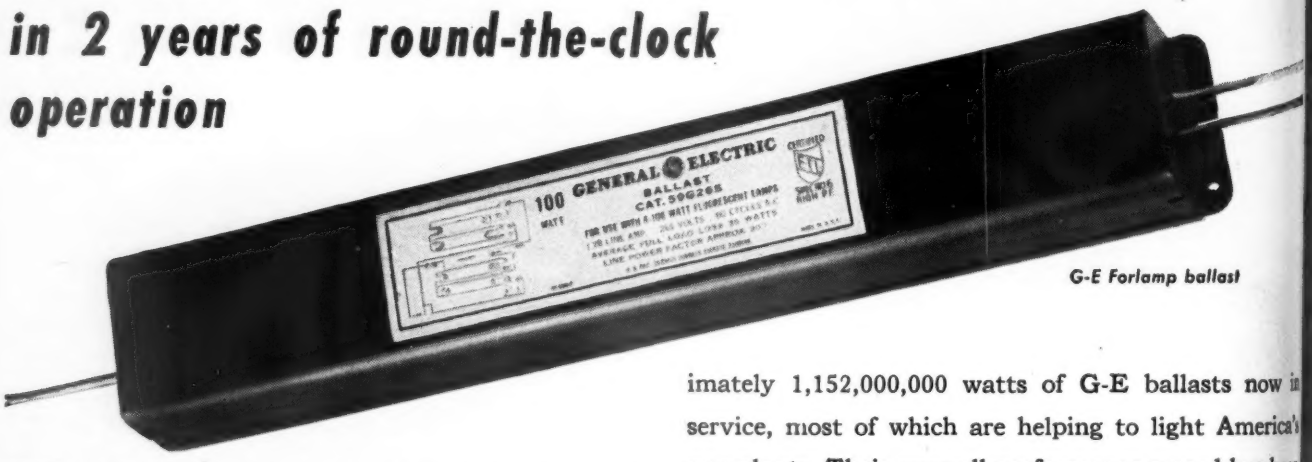
DECEMBER
1944

e Magazine of
ELECTRICAL CONSTRUCTION AND MAINTENANCE

IN THIS ISSUE . . . Wiring organization and methods that helped build the Navy's floating drydocks . . . How West Point is preventing eye defects with modern lighting methods in dormitories . . . Brazing technique for assembling armature windings . . . How a plant sound system overcame high noise levels . . . Planned maintenance methods for fluorescent lighting systems . . . and many useful methods for the shop and job.



ONLY 6 have failed electrically in 2 years of round-the-clock operation



G-E Forlamp ballast

THREE years ago, 12,696 G-E Forlamp ballasts were ordered for the large fluorescent lighting installation at this Midwestern bomber plant. About 12,000 units were actually installed, the remainder to be used as spares. The lighting was turned on in October, 1942.

To date, only six ballasts have had to be replaced on account of electrical failures. Because of this record, the maintenance engineer plans to list as surplus most of the remaining ballasts he has in stock.

This experience is not unique. There are approximately 1,152,000,000 watts of G-E ballasts now in service, most of which are helping to light America's war plants. Their over-all performance record has been better than 99.5 per cent perfect.

Our newly revised catalog (GEA-3293F) contains complete information on our comprehensive line of single-lamp, Tulamp, three-lamp, and Forlamp ballasts, including data on the new, two-way-lead design that permits the leads to be brought out either the ends or the bottom of the ballast case. Ask your G-E representative for a copy, or write to General Electric Company, Schenectady 5, N. Y.

Buy all the BONDS you can — and keep all you buy

GENERAL ELECTRIC

"High, wide" — yes, and "handsome", too!

The ladder that never interrupts production

Practically numberless working positions—many inclinations, height-variation foot by foot and full 360° rotation—all with practically automatic operation.

Crows'nests of varying heights, mounted on live skids, caster trailers, carriages, motor trucks or other suitable bases are doing important up-in-the-air jobs — indoors and outdoors — speedily, efficiently, safely. Fluorescent lights mounted over machines or benches are serviced without interrupting production.

Crows'nests are mighty useful, too, for inspecting, building, servicing and repairing planes in nearly every manufacturing plant and at airport after airport. For proposal, specify working height, sideways-reach and aisle-width, if any. No obligation. Metropolitan Device Corporation, Brooklyn 16, N. Y.

Murray crow's'nest

ACCLAIMED AMERICA'S No. 1 MAINTENANCE LADDER — *for indoors and outdoors*

Send for informative technical data

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Added Protection for Hazardous Locations

APPLETON "FSQX"

Explosion-Proof Receptacle

MAKES EXPOSED HOT TERMINALS IMPOSSIBLE

Be Sure to Read 10 Features Listed Below

Danger from portable electrical equipment in oil refineries, and chemical, rubber and similar plants where explosive gases are present, is avoided by installation of Appleton "FSQX" Explosion-Proof Dead End Receptacles.

Exposed hot terminals are impossible with the "FSQX" Receptacle. The switch cannot be thrown "ON" until the polarized plug is completely inserted and all terminals are fully engaged. The plug cannot be withdrawn until the switch is "OFF".

Appleton "FSQX" Dead End Receptacles are foolproof. Their one-piece bodies are unbreakable; made of heavy, malleable iron in Appleton's own foundries. An additional terminal connected to the shell forms a *positive* ground through the entire conduit system.

We believe the Appleton "FSQX" Dead End Receptacle to be the safest in design and construction it is possible to build. Specify it with other Appleton Explosion-Proof products for hazardous locations. Appleton fittings are "STANDARD FOR BETTER WIRING."

10 IMPORTANT APPLETON FEATURES

1. Heavy, unbreakable, malleable iron body—one piece.
2. Finest quality, quick-make-and-quick-break switch.
3. More than ample clearance between live parts of switch and body—roomy, easy to wire.
4. Switch easily accessible—wiring heavily bead-insulated—terminals soldered
5. Deep-threaded aluminum cover, locked in place by special, tamper-proof set-screw
6. Simple, sturdy interlocking device for positive safety—completely housed, won't jam.
7. All contacts, including ground, *must be fully engaged* in order to operate switch
8. Polarized.
9. Tight threaded cover, with rubber gasket.
10. "FP" Plug with cable grip and brass *weatherproof* nut.

The complete Appleton line includes dead-end receptacles and plugs for every kind of installation—general purpose, dust-tight and explosion-proof. All kinds are described and illustrated in the big Appleton Catalog.

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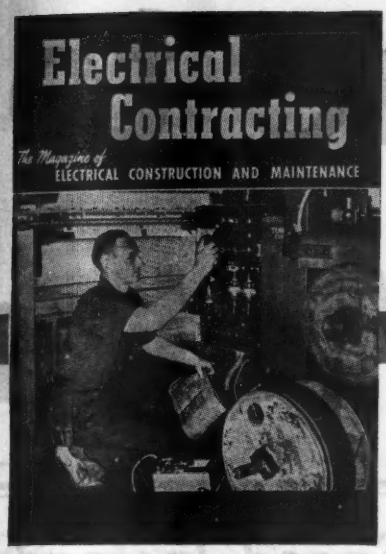

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A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

Electrical Contracting

With which is consolidated *The Electrician and Electrical Record*. Established 1891

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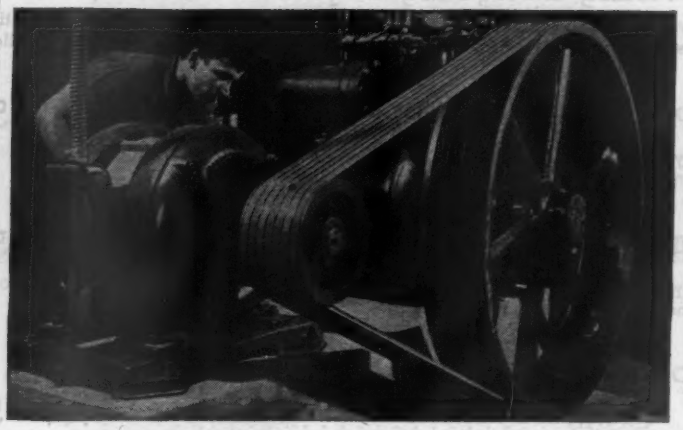
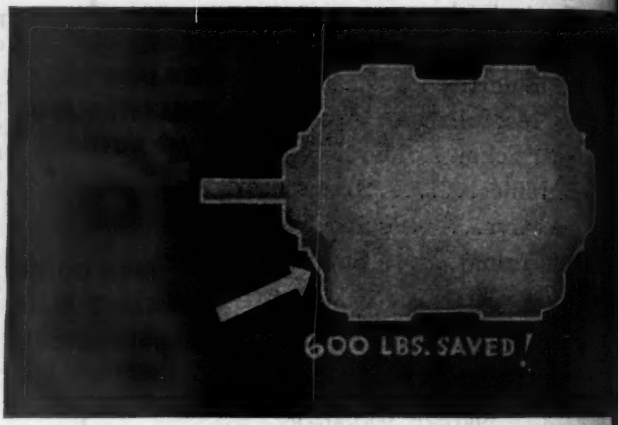
It's Time to Look at Motor

➔You Can Save with High-Speed Instead o

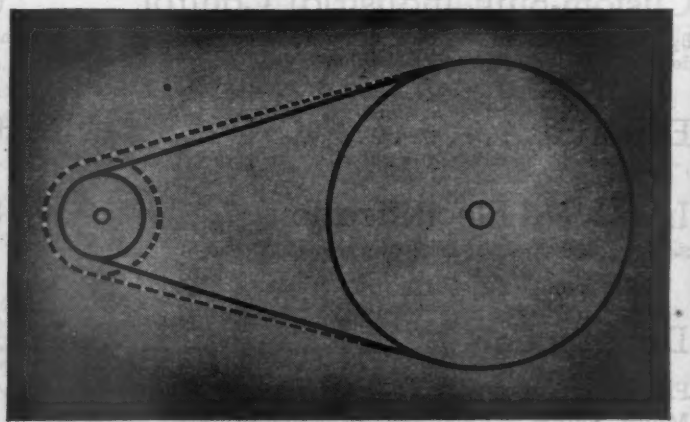


1. In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor . . . *and* give you *exactly* the speed you want — *at lower cost!*



2. When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb o critical materials are saved. And *you* save well over $200—with the drive figured in! This saving is typical.

➔You Can Save with Single-Speed Instead o



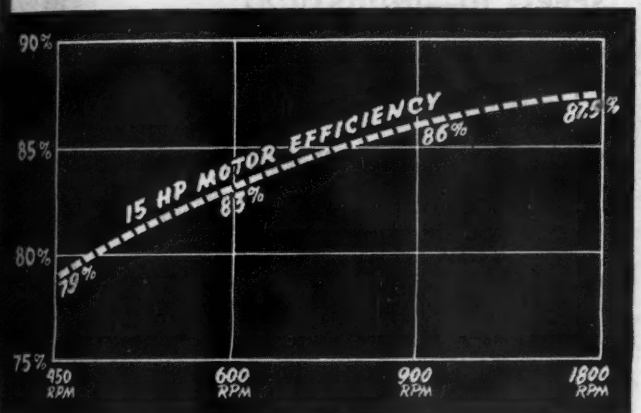
1. Infrequently needed speed changes can be had by changing from one size motor sheave to another. By juggling *complete* drives, speeds can be changed over the full range — from 1:1 to 7:1.

2. With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter, as above. Within limits, an unbroken series of speeds can be obtained.

Take a Fresh Buying!

WAR FORCES HIGHER EFFICIENCIES...

Low-Speed Motors...



3. Note that efficiency rises from 79% for a 450 rpm motor to 87.5% for an 1800 rpm motor. Comparing power consumption, the 1800 rpm motor saves you over 30 kwh/24 hr. day.

Multi-Speed Motors...

3. Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's the most compact, flexible variable-speed transmission available.

It was good business in peacetime to use — as widely as possible — high-speed motors with Allis-Chalmers Texrope Drives...and single-speed motors with Allis-Chalmers Vari-Pitch Sheaves and Speed-Changers. And it's clearer every day that those material and money-saving practices are *vital* practices in time of war!

TODAY the whole picture of buying and applying motors has changed. Note at the left how much you can save for your country *and yourself* with high and single-speed motors made flexible by Texrope Drives.

As America's only builder of both electric motors and V-belt drives, Allis-Chalmers has long advocated the proper combining of motor and V-belt drive.

And today you benefit from Allis-Chalmers' vast, pioneering experience in this field when you ask for and get the *right* combination of Lo-Maintenance Motor and Texrope Drive! Call your nearby district office. Or write ALLIS-CHALMERS MFG. CO. MILWAUKEE, WISCONSIN.

A 1560

Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.

ALLIS-CHALMERS A-C MILWAUKEE

WE WORK FOR VICTORY WE PLAN FOR PEACE

★ These Two Outstanding SPERO Fluorescent Luminaires will answer 90% of your requirements

You can simplify your selection of fluorescent units and, at the same time, save time and money by concentrating on these two outstanding lines—the SPERO IU line for industrial and the SPERO LVR for commercial installation. Both lines incorporate the new and modern design features which improve efficiency and minimize maintenance. Both are available with SPERO INSTA-LITE—providing instantaneous illumination by means of a power unit which combines functions of ballast and starter—thus eliminating all starter trouble.

SPERO IU Line of Industrial Fluorescent Fixtures

The practical industrial luminaire—engineered for high efficiency, long life and easy maintenance. One-piece steel reflector—quickly removable for cleaning. All wiring, auxiliaries and starters are mounted in raceway above reflector. For chain suspension or rigid mounting—singly or in continuous rows. For two or three 40W tubes or two 60W tubes. Available with SPERO INSTA-LITE.

SPERO LVR Line for Commercial Installations

Nationally accepted as the "masterpiece" of fluorescent engineering—combining modern design, high intensity, minimum glare and low maintenance costs. The four 40W tubes are shielded by evenly-spaced egg-crate louvres, minimizing glare. Louvres are hinged at sides for easy maintenance. Plastic side panels shield end tubes. Made for stem or flush mounting—single or multiple. Available with SPERO INSTA-LITE.

★ ★ ★

THE SPERO PLANT STANDS BEHIND THE ELECTRICAL WHOLESALER

In spite of shortages and restrictions, Spero has continued to make and supply customers its regular line as far as possible. Spero products are sold only through legitimate electrical wholesalers.

SPERO IU—INDUSTRIAL

Featuring one-piece metal reflector. Available in the following: With conventional ballast—SPERO IU-248 for two 40W tubes, IU-348 for three 40W tubes, and IU-260 for two 100W tubes; with INSTA-LITE—SPERO IU-248 for two 40 watt tubes, and IU-260 for two 100W tubes.

SPERO LVR—COMMERCIAL

Tubes shielded by evenly-spaced egg crate louvres. LVR-448, for four 40W tubes, conventional ballast and LVRS-448, for four 40W tubes with INSTA-LITE.

Look to SPERO For all Your Present and Post-war Electrical Fixture and Installation Needs

No need to waste time shopping around. Spero offers complete lines of reflectors, floodlights, vaporproof units, surface cabinets and pull boxes and installation equipment—in addition to commercial, industrial and residential fluorescent fixtures—from one reliable source. These products are available NOW, from stock or current production.

Write for complete information.

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THE SPERO ELECTRIC CORPORATION

18222 LANKEN AVE. ★ CLEVELAND, OHIO

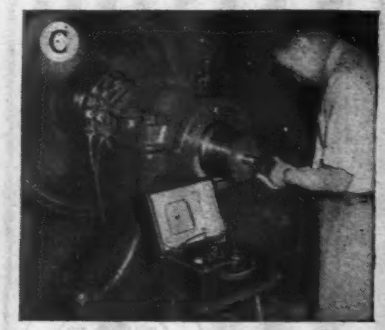
CAN'T QUIVER

Motors driving precision machines can't quiver without affecting the work, particularly when the motor is mounted directly on the machine. The close tolerances required on so much vital war equipment have intensified the need for machines and motors that remain smooth-running, month after month, in three-shift service. Why have G-E Tri-Clad motors gone on—and stayed on—so many high-precision machines? Our test procedure for balance and vibration is an important part of the answer.

High-precision recessing machine in Waltham Watch Company plant, driven by G-E Tri-Clad motor

G.E.'s vibration tests and balancing procedure help make TRI CLAD motors smooth-running and quiet

Unmatched experience in making vibration studies, especially our work on high-speed turbines, helped us to perfect dynamic-balance techniques and devices that give assurance of smooth-running motors. Every Tri-Clad rotor is dynamically balanced, and in addition, spot-checks of assembled motors are made: (A) making an electronic dynamic-balance test on Tri-Clad rotors; (B) spot-check with G-E vibration indicator, with motors on elastic mountings; (C) portable electromagnetic tester being used on large motor. This test can also be applied to a motor installation, if desired. *General Electric Company, Schenectady 5, New York.*



GENERAL ELECTRIC

TRI CLAD MOTORS

Buy all the BONDS you can—and keep all you buy

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*

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BACK in the days when America was producing "too little and too late," the electrical industry had to accept certain less-than-excellent practices for wiring buildings. Codes that have insured safety under all conditions had to be suspended in the face of dire emergency. But, of course, plants with this emergency type of wiring were designed to operate that way only a few years at most.

Today, America is thinking about converting these plants to permanent peacetime use. So it is extremely important that all temporary wiring systems be converted, too--through replacement with permanent, full-weight, standard-threaded, rigid steel conduit systems.

Buckeye conduit, known everywhere for its high excellence and uniform quality, gives maximum protection against tampering, crushing, dust, dirt, moisture, vapors, vibration, explosions. It is available now through your distributor.

For your new peacetime jobs, as well as for reconversion jobs, you can now throw out makeshift wartime practices and specify and use BUCKEYE conduit, to insure permanent wiring protection of which you can always be proud.

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YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

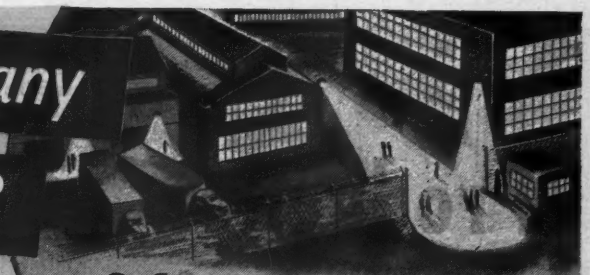
YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit...Pipe and Tubular Products...Sheets...Plates...Electrolytic Tin Plate...Coke Tin Plate...Bars...Rods...Wire...Nails...Tie Plates and Spikes.

Which–Where–How Many for daylight after dark?



G-E TECHNICAL ASSISTANCE CAN HELP YOU MAKE MOST EFFECTIVE USE OF **NOVALUX** FLOODLIGHTS

A few of the more popular NOVALUX FLOODLIGHTS

TYPE	WATTAGE	GENERAL CLASSIFICATION	APPROXIMATE NET PRICE RANGE
L-66	200	General Purpose	$8.25
L-38	200/250	Heavy Duty General Purpose	$25.42
L-49	300/500	General Purpose	$18.10 to $21.42
L-30	300/500	Heavy Duty General Purpose	$45.60
L-43	750/1000	General Purpose	$23.42 to $26.80
L-45	750/1500	Area Floodlight	$11.40 to $16.75
L-46	750/1500	Area Floodlight	$18.75 to $25.10
L-68	750/1500	Area Floodlight	$28.10 to $32.90
S-18	900/1500	Searchlight	$134.00 to $214.40

**List prices subject to your usual discount.*

The problems of floodlighting for outdoor production or protection are often such that choice of the right units for the right installation points calls for highly experienced installation guidance.

No matter what the problem may be, G-E lighting specialists can help you decide *which lights to use* and *how to install them.* And whether the job calls for one light or a thousand, you will find what you need in G-E Novalux floodlights—lights with the correct wattage, beam angle, and construction for effective illumination and economical operation.

Take advantage of these efficient, high-quality fixtures, and of the technical service back of them. For full information on *both,* get in touch with the nearest G-E office or authorized agent. *General Electric Co., Schenectady 5, N. Y.*

NOVALUX
Floodlights

GENERAL ELECTRIC

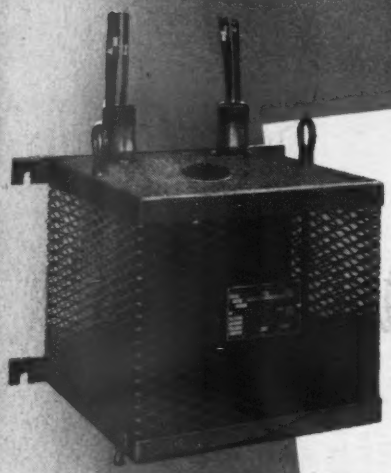
BUY WAR BONDS

One of the larger Standard Dry-Type Transformers. Class B insulation (fibre glass, mica, etc.)

Production Conversion Problems *made easier* with Standard

TRADE MARK

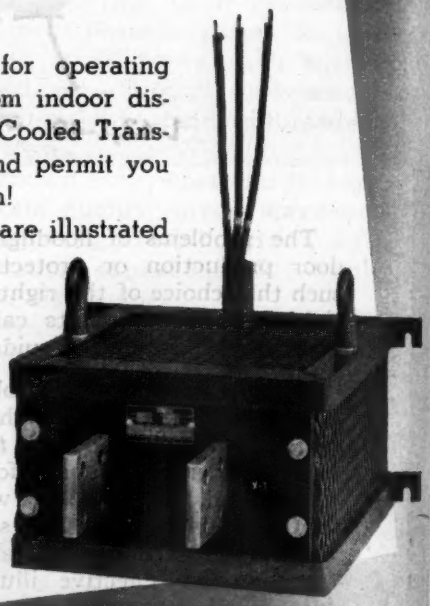
DRY-TYPE TRANSFORMERS



Wall mounting, air-cooled type with expanded metal protecting case. Popular for installation close to driven machine.

For relocating plant machinery, for operating low-voltage power and lighting from indoor distribution systems—STANDARD Air-Cooled Transformers save copper, save labor and permit you to get highest efficiency of operation!

Some of the more popular types are illustrated here. Floor, wall or overhead mounting, capacities up to 500 kva, single phase—1,000 kva, three phase—highest quality construction throughout. Special service on designs to suit your particular needs. Write for Bulletin S-202 today.



Specially designed and built to deliver heavy current from 115 volt circuit. Capacity, 3 kva. Standard has exceptional facilities for providing special designs and construction.

Typical weatherproof construction of Standard air-cooled transformer. Case is filled with moisture-proof compound which makes entire structure a solid unit.

THE STANDARD TRANSFORMER COMPANY

Makers of Transformers for Distribution and Power, Metering, Street Lighting, Testing, Dry and Liquid Filled Types

WARREN, OHIO

Representatives in 29 Principal Cities

Select the RIGHT CABLE INSULATION for HOT INSTALLATIONS...

for MOIST INSTALLATIONS...

Selection of the right insulation for each installation is of prime importance. A single circuit may even call for two different types of insulation, to safeguard against heat or moisture.

HAZARD Performite Heat-Resisting Insulation TYPE RH

HEAT RESISTANCE — The official maximum temperature rating of Performite insulation is 75°C. Code Grade insulation limit is 50°C. A given size wire with Performite insulation will therefore safely carry 50% *more* current than wire with Code Grade insulation, thus providing spare capacity for future use.

MODERATE ADDITIONAL COST — The 50% added capacity of Performite over Code Grade insulation increases the cost only 33⅓% on the average (29% on 500 MCM., 34% on 4/0, 41% on No. 2 and 50% on No. 4).

REDUCED CONDUIT COST — Smaller conductor sizes enable the use of smaller conduit and fittings, where original wiring is designed for Performite heat-resisting insulation. The overall cost of Performite and its small conduit is often no greater than the cost of Code Grade insulation and its large conduit. Consequently, the super-aging qualities of Performite can be obtained at practically no extra cost.

PERFORMITE IN ALL TYPES OF CABLE — Type RH insulation, although used most extensively for Braided Building Wire, is also available in Lead-encased Cable for wet locations, in Hazardex Non-Metallic Sheathed Cable and in Hazard Armored Cable.

HAZARD Watertite Moisture-Resisting Insulation TYPE RW

MOISTURE RESISTANCE — For many years Hazard Watertite insulation, made with natural crude rubber, had been used for Non-Leaded Submarine and Non-Metallic Armored Underground Cables as well as for braided Building Wire for use in moist locations. Because of wartime restrictions its manufacture was temporarily discontinued.

AVAILABILITY — Now after exhaustive research in our laboratories a satisfactory moisture-resistant insulation has been compounded using Buna S synthetic rubber (GR-S). So Hazard Watertite insulation is again available.

TESTS — Long-time water immersion tests, accelerated aging tests in the air oven and oxygen bomb, together with insulation resistance and dielectric strength tests, certify to its excellence under moist conditions.

APPROVAL — Hazard Watertite Type RW Wire is fully approved by the Underwriters' Laboratories for use in moist locations as an alternate for Lead-encased Cable. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pennsylvania.

3809

ARMY E NAVY

HAZARD

insulated wires and cables for every electrical use

For
CLEAN, DRY AREAS
Standard open-type induction motor

For
WET, EXPOSED AREAS
Splash-proof, drip-proof induction motor

For
DRY, DUSTY AREAS
Totally enclosed, fan-cooled induction motor

Uni-Shell MOTORS ARE EASY TO SHIFT

THEY SPEED MACHINE TOOL RELOCATION

Is the relocation of motor-driven equipment a tough problem? Will new sites require other types of motors because of the different kind of work to be done? Will those new locations present a change from a dry atmosphere to one that is damp, from clean to dust-laden air?

In any case, R & M Uni-Shell Motors can make the change-over job a lot easier. That's because they're interchangeable. All critical motor dimensions on any one frame size are exactly the same. Uni-Shell Motors, whether they be open-type, splash-proof, or totally enclosed, will all fit a single mounting. And that goes whether they're polyphase, single-phase or direct-current.

Yes, the job of getting set to meet that new competition can be made easier. An illustrated, 20-page booklet on R & M Uni-Shell Motors contains information that will help. A copy is yours for the asking. Send for your copy of Bulletin 1845, today.

SHIPMENT NOW!

Ample stock on most types of integral motors on hand as this goes to press. Wire or phone your inquiry.

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MOTOR DIVISION, SPRINGFIELD, OHIO
HOISTS & CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

...one of Industry's finest examples of practical **PREFABRICATION!**

TRUMBULL CONTROL CENTERS

FOR MOTOR AND BRANCH CIRCUIT CONTROL

Step 1

INSTALL PREFABRICATED VERTICAL SECTIONS

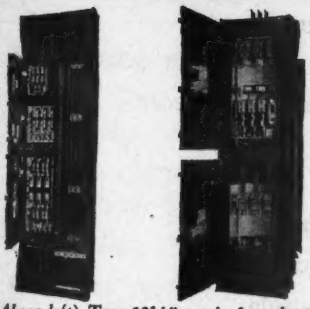
13½" and 27" wide vertical sections, containing built-in bus bars, accommodate various types and capacities of units for control of motor, lighting or power circuits. Any number of these sections may be grouped together into a control center.

As sections are of uniform height and depth, control centers may be expanded or rearranged at any time to meet changing requirements.

All connections and parts are easily accessible from the front, making it possible to mount these sections back to back or flat against the wall.

Ample wiring gutters — pull boxes top and bottom.

In a matter of HOURS instead of days or weeks, sections are lined up, connected to mains, and then . . .

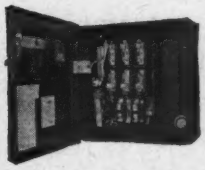


(*Above left*) Two 13½" vertical sections—one showing construction — the other, Sizes 1, 2 or 3 motor control units in place — pull boxes top and bottom.
(*Above right*) A 27" Vertical Section with Size 4 motor control unit at top — 600 amp. disconnect switch below (Switchboard control unit).

Step 2

Plug in PREFABRICATED CONTROL CENTER UNITS

. . . just "plug in" magnetic starter control units . . . sizes 1, 2 or 3 . . . onto bus bars in 13½" wide sections: or assemble size 4 combination units and 400 and 600 amp. switches or circuit breaker control units in 27" wide sections. You now have complete centralized control of any desired number of motors (a motor control center) . . . or protection and control of power and light feeder circuits (a switchboard control center) or both types of units may be assembled on same control center.



Size 1 Fusible Magnetic Motor Control unit.

Showing stabs on control unit in contact with bus bars in 13½" vertical section.

(*Right*)
Removing control center unit from 13½" vertical section.

THE *Result*

- centralized and sectionalized control of plant power motors, or branch feeder circuits . . . with adequate protection against shutdowns.
- ample capacity, uniformly dependable service . . . with the highest degree of safety for ALL equipment in a department.
- actual unlimited flexibility for present and future needs . . . because EVERYTHING is standardized, adjustable, expandable.

For complete details write for Trumbullaid No. 411

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY PLAINVILLE, CONN. A GENERAL ELECTRIC ORGANIZATION

OTHER FACTORIES AT NORWOOD (CINN.) O. — SEATTLE — SAN FRANCISCO — LOS ANGELES

OVER A HALF CENTURY OF PRACTICAL FIELD TESTS . . .

in every type of electrical equipment from generators to wall switches!

Can you use the services of an expert with 50 years' experience in testing, developing and specifying insulating materials?

Then specify the Westinghouse line of "Tuffernell" Insulating Materials. They're the result of *fifty years of field tests* with every type of electrical equipment.

This Westinghouse experience with all conceivable types of insulating materials has built up an authoritative file of exact application data. All of it is made available to you through Westinghouse Insulation Specialists. Call on them for help in your insulating problems.

Valuable material from this "insulation know-how" is now made available to you in the new Insulation Sample Book. This simplifies selection of varnishes, tapes, fabrics and papers *with actual samples*. Copies are available through your nearest Westinghouse distributor. Ask for B-3322. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

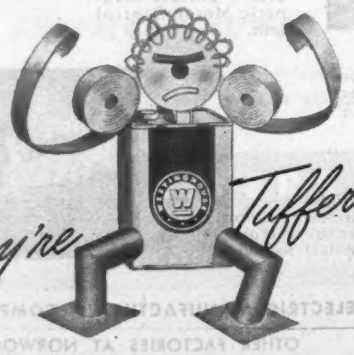
J-06358

Hang up this new Insulation Sample Book for handy reference. It simplifies selection, ordering and application of Micas, tapes, fabrics and papers.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

INSULATING MATERIALS



MOGUL CONDULETS

have **extra** room for pulling large electrical cables and for splices

(CONDULETS are manufactured only by Crouse-Hinds)

Extra long wiring chamber facilitates the handling of large electrical conductors.

Types. The variety of types of Mogul Condulets simplifies the layout of conduit systems for large conductors.

Covers. Dome-shaped blank covers in sheet steel or cast Feraloy provide extra wiring space. Blank or wire-hole covers in Bakelite. 1-wire to 9-wire.

Sizes. For 1-inch to 6-inch electrical conduit.

Gaskets available for vaportight or raintight installations.

Listed in Condulet Catalog No. 2500, Section 5, Pages 17 and 18.

Comparison of size of Type BC4 1¼" Mogul Condulet and Type C47 1¼" Obround Condulet.

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SYRACUSE 1, N. Y., U.S.A.

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POWER CIRCUIT TRANSFORMERS WITH OVERLOAD and SHORT CIRCUIT PROTECTION

Safety and Utility

IN ADDITION to providing lower voltage from the higher voltage plant distribution circuits, Jefferson Power Circuit Transformers with built-in Circuit Breakers, give overload and short-circuit protection.

In connection with remote control station, for example as shown in the illustration, these transformers make possible a combination that meets the electrical safety standards of the National Machine Tool Builders Ass'n.

Mounting transformers directly on machinery has come into wide use also where in addition to supplying lower voltage for small electric appliances, localized lighting units are employed as a means of reducing eye fatigue and improving output.

Jefferson Power Circuit Transformers are used in America's leading War goods and essential industrial plants. Chances are you can gain by their use also. Let us have your problem or write today for Bulletin 421-PCT . . . For your convenience Electrical Wholesalers everywhere carry Jefferson Electric Products . . . JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago), Illinois. *In Canada:* Canadian Jefferson Electric Co., Ltd., 384 Pape Avenue, Toronto, Ont.

Jefferson Electric Transformers being the dry type may be mounted at any convenient location on wall, post, or directly on the machine to provide the lower voltage current required for small electric tools, appliances or controlling equipment. The wiring compartment has outlets for secondary connections.

For close tolerance or special work, many individual machine tools are equipped with separate lamps. Transformers to provide the lower voltage current are mounted on the machine and may be furnished with an "on" and "off" switch, and a receptacle to accommodate lamp-cord attachment plug.

JEFFERSON ELECTRIC

Power Circuit TRANSFORMERS

Available Now for Prompt Shipment

THE FAR EAST

Frontier for American Enterprise

IN THE great tradition of America, our frontier lies to the West. But for a United States that stretches from the Atlantic to the Pacific, to Go West is to arrive in the Far East. The feet of literally millions of our young men are now set upon that route.

Accomplishment of their objective—the defeat of Japan—will not end our responsibilities to the Orient any more than the defeat of Germany will end our responsibilities to Europe. This time we mean to see the venture through.

The first sketch of a political program for enlisting the strength of nations of good will to enforce the peace was drawn at Dumbarton Oaks. That is a good start. But those who participated know how much work remains before the blueprint becomes a fully matured plan, the plan becomes a structure, and the structure takes life and effective being in the living imagination and will of the peoples of the world.

No political accord, however high its purpose, can endure for long if it depends upon the loyalty and support of populations embittered by hopeless poverty that is offered no promise of relief. The poisonous dust of mass despair makes inevitable an ultimate explosion, whether it be sparked by a torch supplied from without or by its own internally generated heat. Much of the Far East is sufficiently close to that position to pose a grave problem to the Western world. It is of particular importance that American business men and workers alike recognize the nature of their responsibility in the matter, for to them the great area of the East presents also an opportunity and a challenge.

☆ ☆ ☆

The Orient—stretching in a vast semicircle from Manchuria and Japan to India and Ceylon—is the home of more than a billion people, the world's greatest potential market. In its mountains are the earth's richest stores of tin and mica; its deposits of iron ore, coal, and manganese rival those of France, Russia, and the United States. Its rice paddies are the most productive in the world, its coconut and rubber plantations the largest, and its cotton production is of major volume.

And yet, this fabulous region—with its riches of manpower and raw materials—suffers from living standards at the lowest rung of the world scale. With as much as 85 per cent of the populations of this great area devoted to the production of farm products, starvation has been an endemic plague to countless millions of its inhabitants, and will remain so until they graduate from the crudely primitive methods of the crooked stick and the bamboo plow to the use of the implements of a modern world in both agriculture and industry.

The improvement of agricultural methods and the burgeoning of industrial development depends upon tools—a preponderance of simple tools, no doubt, at the beginning, for modernization of economic processes is a development that cannot be forced at a rate faster than the ideas upon which they depend can be developed. If we, in the United States, are to hope to supply a major portion of the implements upon which the salvation of the East depends, we must be prepared to export also the skills and technologies which will make their effective use possible.

The possibility of a world market for machinery and manufactured products is a challenge that American industry cannot afford to ignore. The United States will emerge from the war with almost half of the world's industrial capacity within its borders, with much more than half of the heavy industries. Drastic and painful readjustments are inevitable; but they can be mitigated to the extent that we can find outside markets for the products for which we have excess capacity.

We shall find ourselves, at war's end, in a singularly favored position to compete in any equipment markets which are open. It is not merely that we shall have the productive capacities crying for outlets. Aside from Germany and Japan, which for some time will not be in a position to compete, our two major industrial Allies, Great Britain and Russia, will face enormous tasks in providing for their own rehabilitation. Neither of them is likely to be in a position to export more capital than they absorb; and although Canada, Sweden, and Switzerland will be, the United States will stand alone as the one major creditor nation in the world. If the potential advantages of this position are managed with wisdom and imagination, they will enormously enhance our opportunities for supplying a great share of the capital goods demand of undeveloped areas.

☆ ☆ ☆

What is the dimension of the Far East's potential demand? What are some of the difficulties standing in the way of its being realized?

If needs were the only measuring stick, the Far Eastern market would provide a bottomless pit into which even the great stores of our exportable capacity could be poured with room to spare.

China, alone, with its teeming population of 450 millions, has spelled out needs in dimensions large enough to stir the imaginations of the equipment producers of the world.

Business Week (February 5, 1944) supplements Dr. Sun Yat-Sen's spacious first estimates of the requirements for a thorough-going industrialization program with figures provided by current Chinese planners—25,000 locomotives; 300,000 freight cars; 20,000 passenger coaches; 20,000,000 tons of steel; and 90,000 power driven machine tools for the first five years of reconstruction. An American manufacturer of farm equipment, who recently surveyed the agricultural requirements of China, estimates an ultimate Chinese market for 20,000,000 tractors.

India's drawing-board plans are equally expansive. According to the bold pattern drawn up by a group of Bombay industrialists—some of whom are due to visit the United States early in 1945—India, after the war, will require a capital investment of $2,000,000,000 a year over the next 15 years, of which $250,000,000 per year for the first seven years will be in the form of imported capital goods.

Included on the huge import order list of the Bombay executives are mining, roadbuilding and power station equipment, heavy locomotives, metallurgical plants, agricultural machinery, and a long list of machine tools.

There can be no question of the need of these countries for the industrial equipment—and for many items of manufactured goods—which we are so eminently in a position to supply. But realism requires that we measure this demand against the Far East's probable capacity in the relatively near future to absorb industrial goods.

A Chinese economist has estimated that China, in 1937, had a total industrial capital investment of about $1,000,000,000 in American values, or something like $2.50 per capita of population. In contrast, the American investment, in manufacturing facilities alone, is now more than $600 per capita.

What it could mean in terms of capital goods requirements if China alone carries out this dream of modernizing, not to the utopian level of the United States but to the present modest level of the less developed Soviet Union, is typified by measuring just three lines: 500,000 tons of steel a

year, for five years, to add 12,500 miles to the railroad system; 2,187,500 motor vehicles; 3,300,000 telephones.

But it is one thing to cite mountainous figures demonstrating needs. It is another, and far less optimistic exercise, to find assurance that practical opportunities for satisfying such needs can be made to materialize. Let us face some of the major difficulties and see if they are insurmountable.

☆ ☆ ☆

The first hurdle to be cleared is the question of whether or not we want to promote the industrialization of the Far East. The wisdom of doing so has been vigorously challenged. The negative argument, on the economic side, generally runs thus: If we provide industrial equipment to backward economic areas, we deprive ourselves of the greater long-run opportunity of selling them manufactured articles which our aid has enabled them to produce for themselves.

It is only fair to say that such a thing might happen—that it has happened in isolated instances in the past. But the overwhelming weight of economic history demonstrates that the broader attitude is also the profitable one.

The United States itself is the living refutation of the fear which now cramps the outlook of many of its own citizens.

From 1790 until 1850 the foreign trade of our new fledged Nation had many of the characteristics which pertain to the trades of China and India today. We imported manufactures and we exported raw materials, agricultural products, and newly mined gold. Our imports exceeded exports, the difference being made up partly by payments to us for shipping services and partly by industrial development loans. It is relevant to inquire how the trade of the lenders was affected by this policy of supplying us with industrial capital and machinery.

From 1850 through 1939 the pattern of America's foreign trade changed. Slowly at first, and then at accelerated pace, our import ledger showed a percentage decline in manufactured goods and a percentage rise in raw materials to feed our expanding industrial facilities. But while finished manufactures declined percentagewise in our import budget, so great was the increase in our total foreign trade operations in the century from 1830 to 1930 that our imports of manufactured goods increased more than twentyfold, and they more than doubled between 1900 and 1939.

Clearly industrial Europe gained rather than suffered from the industrialization of the United States, and it is equally clear that we, in turn, shall benefit from the industrialization of the world's undeveloped territories. Further evidence is provided by Canada which, with its high industrial development but only 12 million people, buys from us each year almost as much as the relatively unindustrialized 130 million people south of the Rio Grande.

If it be granted, as I believe it must, that the development of Far Eastern countries will be to our advantage as well as theirs, the second question that we should face is the speed with which it can be accomplished. Is there genuine promise in the proximate future of opportunities for American enterprise of the magnitude set forth in the estimates quoted above?

In all fairness, I am forced to state my conviction that the road is longer than is indicated by Chinese and Indian leaders. It is natural, and far from censurable, that their eyes should be focussed upon the urgency of national needs, rather than upon obstacles in the way of their fulfillment.

On the other hand, it is possible that our own long process of industrialization may lead us to conclusions of undue conservatism. Ideas, once they break the crust of resistance are the most contagious of bacteria, and the tempo of their infiltration seems to increase by geometrical progression in a world of swift communication.

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In an interesting recent study of The International Labor Office, it is suggested that the general economic level of the rest of Asia outside Japan in the late 1930's was not dissimilar to that of Japan in 1900. Between 1900 and 1936, Japan increased its total capital investment more than threefold devoting between 10 and 17 per cent of its annual income to capital outlays. A comparable tempo of development for China, India, and other Asiatic areas would result in a capital expansion that would dwarf to insignificance the most optimistic blueprints that have been put forth to date. I am not suggesting this as a likely possibility, but rather as a caution lest we, in the name of hard-headed realism, underestimate Asiatic potentials as much as their own nationals exaggerate them.

Finally, in appraising the outlook for American enterprise in Far Eastern markets, we collide, head-on, with the problem of how we are to be paid. Here, hard-headedness can be only a virtue, for the lack of it will breed inevitable disaster for the Asiatics as well as for us.

In the last analysis, the dimension of the American market in the Far Eastern countries will be determined by the dollar exchange at their command, obtained through the products, goods, and services which they are able to provide to us, with due allowance for multilateral trade arrangements. It is true that the balance temporarily can be distorted through the extension of developmental loans. There is little question but that such loans will be in order after the war, and if they are wisely made, for productive projects that eventually will increase the exporting capacities of the countries to which they are extended, they can be thoroughly justified. But the best loans provide only a temporary expedient. In the long run, the balance of current payments must be restored with sufficient margin to provide interest payments and finally amortization of principal.

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How, then, are we to attack the problem of increasing our imports from the Orient?

In 1937, the total exports of the Far East amounted to something over $5,000,000,000—a little less than $1,500,000,000 in foodstuffs, a little more than $2,500,000,000 in raw and partly manufactured materials, and better than $1,000,000,000 of manufactured articles. Of this total, the United States purchased only about 20 per cent—approximately 10 per cent each of the foodstuffs and manufactures, and 30 per cent of the materials.

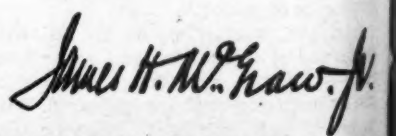
Despite changes in our technologies which will probably reduce our future takings of such important items as rubber and silk, the achievement of a high level of economic activity in this country after the war will provide a basis for increasing our Eastern imports, but only if it is an accepted part of our national policy to do so.

This means an alert and aggressive exploration of two-way trade possibilities on the part of both American business and our governmental agencies. It cannot be done by either alone.

The war has dislocated many of the trade patterns that prevailed in the past. The East is hungry for the type of products which we, uniquely, are situated to supply, but it will make its bargains with those who will not only fill its needs but will also provide outlets for its produce. Even the prewar magnitude of the exports from this area provides ample margin for the most meticulous and imaginative shopping of Eastern markets with the aim of increasing the modest share of our prewar purchases. And a farsighted program of development loans can greatly increase the capacity of these countries to produce what we want.

In general, we can trust American enterprise to explore rigorously all likely export opportunities. But the equally vigorous investigation of import possibilities will require a break from past traditions on the part of American business and American government.

Both East and West must learn to think in new patterns for the successful opening of a new frontier.



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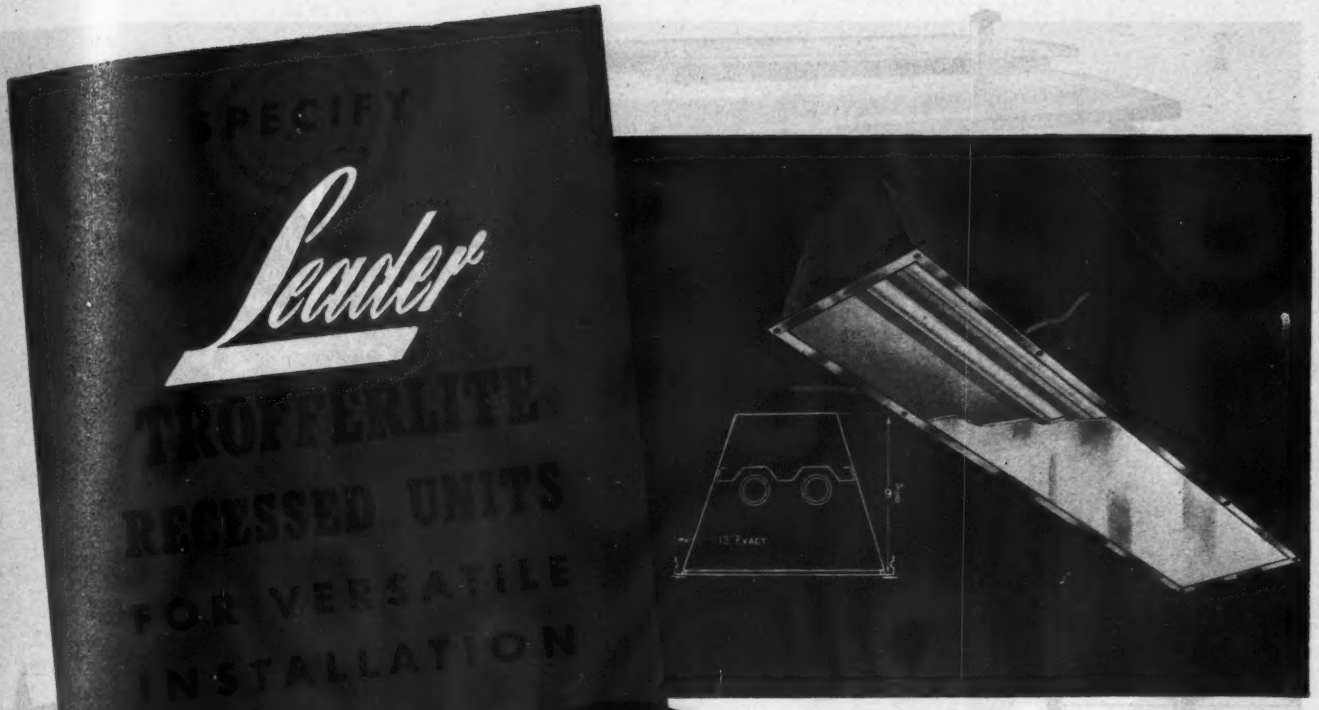

POSTWAR LIGHTING *Now*

Postwar lighting in stores, offices, factories, schools and homes can now be planned by specifying the New Leader Trofferlite Recessed Units—designed for versatility in installation, modern continuous construction and savings beyond comparison.

LEADER EXPERIENCE PLUS LEADER QUALITY INCORPORATED IN LEADER TROFFER UNITS

Choice of glass enclosed or open models with adjustable louvers, the new Leader Trofferlite Recessed Units are made in 24" two and four light sections, and 12" one and two light sections.

Constructed for conventional or instant start operation and furnished for 40 watt tubular bulbs, Leader Trofferlites are a step ahead with recessed units to take the new 7'9" lamp when this equipment is available. Contact the Leader representative in your city for plans and suggestions on postwar lighting now.

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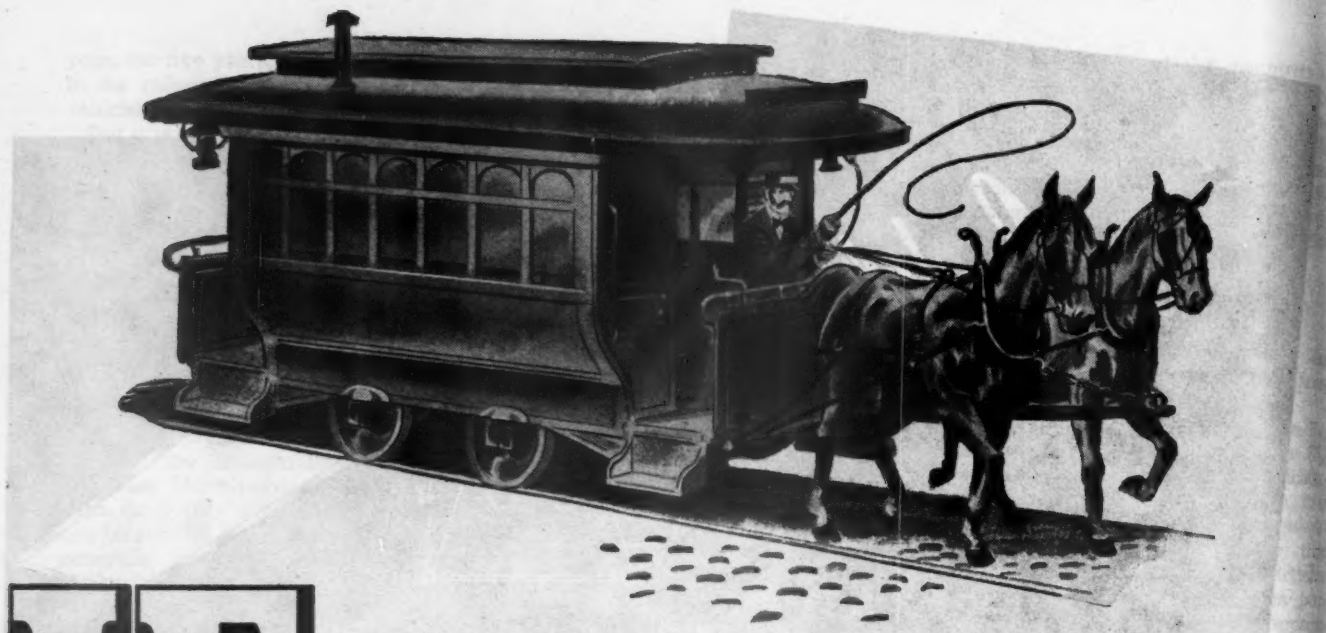


IF you want today's best...

not yesterday's

This ad—third in a series on "De-ion" (fuseless) Circuit Breakers for 1944—is addressed to those men in American Industry who want today's best . . . who believe that yesterday's best should remain history.

Every industry, large or small, depends almost wholly on 115, 220, 440 or 550-volt circuits for electric power. These circuits demand modern protection.

Older methods of circuit protection, like horse cars, at one time were adequate—possibly—for the job. But today, the job has outgrown them. New and better circuit protection . . . like new and faster transportation . . . makes continued operation of old equipment, in many cases, both unwise and costly.

Operating and management executives will do well to consider this question:

"Are our circuit protective devices really adequate for today's conditions and equipment—or are "horse-car" methods costing us lost time, delays and unnecessary risks to men and machines?"

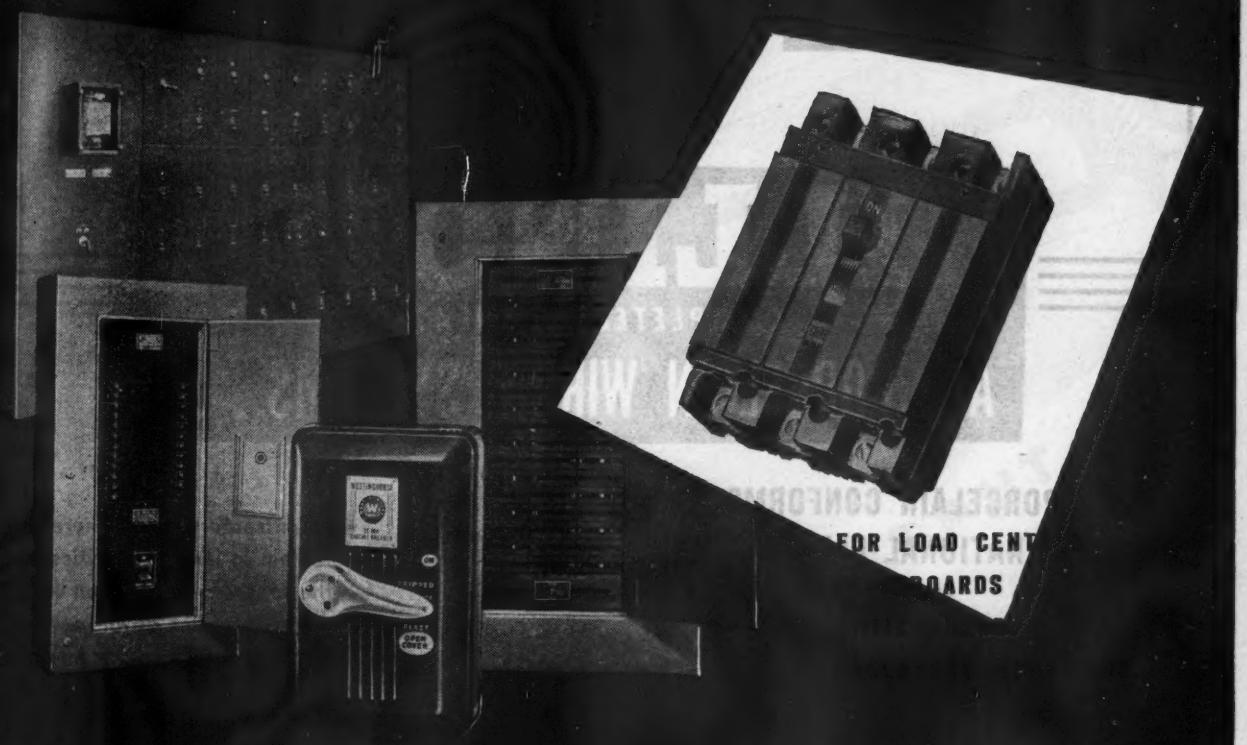
The facts on the opposite page may help answer this question.

J-60565

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

there's only **ONE** adequate type of circuit protection for modern plant equipment....



"DE-ION" *(fuseless)* CIRCUIT BREAKERS

here's why...

1 **More positive protection for circuits and machines.** "De-ion" Breakers give accurately calibrated, *automatic* protection against severe overloads and short circuits . . . the same protection that safeguards vital equipment on our modern battleships.

2 **Keeps machines on the job.** No unnecessary time out—"De-ion" Breakers do not interrupt production on harmless momentary overloads. When breaker does operate, service can be restored simply by closing the breaker. Nothing to replace or repair—no idle time lost waiting for special maintenance attention.

3 **Greater Safety.** Completely molded insulated enclosures are positively sealed to protect workers and maintain calibration. Circuit breakers cannot be blocked with coins, nails, or other foreign articles.

4 **Lower costs**—"De-ion" (fuseless) Circuit Breakers have a lower lifetime cost. Nothing is destroyed or requires replacement when breaker operates. Ask your Westinghouse representative for facts and figures. Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Penna.

"DE-ION" *(fuseless)* CIRCUIT BREAKERS

MEET THE DEMAND WITH ILLINOIS

COMPLETELY INSULATED

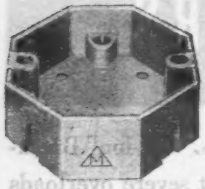
ALL PORCELAIN WIRING SYSTEMS . . .

PORCELAIN CONFORMS TO THE NATIONAL ELECTRIC CODE

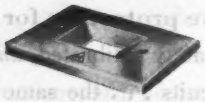
TOGGLE SWITCH PLATE

Look for this Trade Mark

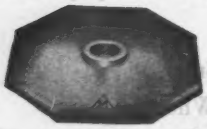
STANDARD TUBES



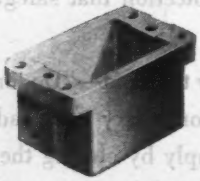
STANDARD KNOBS

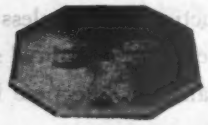


SWITCH BOXES AND COVERS

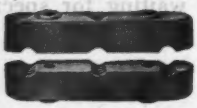


OUTLET BOXES AND COVERS





DUPLEX RECEPTACLE COVER



CLEATS

★ Contractors everywhere know that Porcelain in large quantities is available —that, therefore, they can do wiring jobs today with no let down in wiring quality —that they still can assure customers of permanency, dependability, and economy—that simplified modern installations are the result of the use of All Porcelain Wiring Systems.

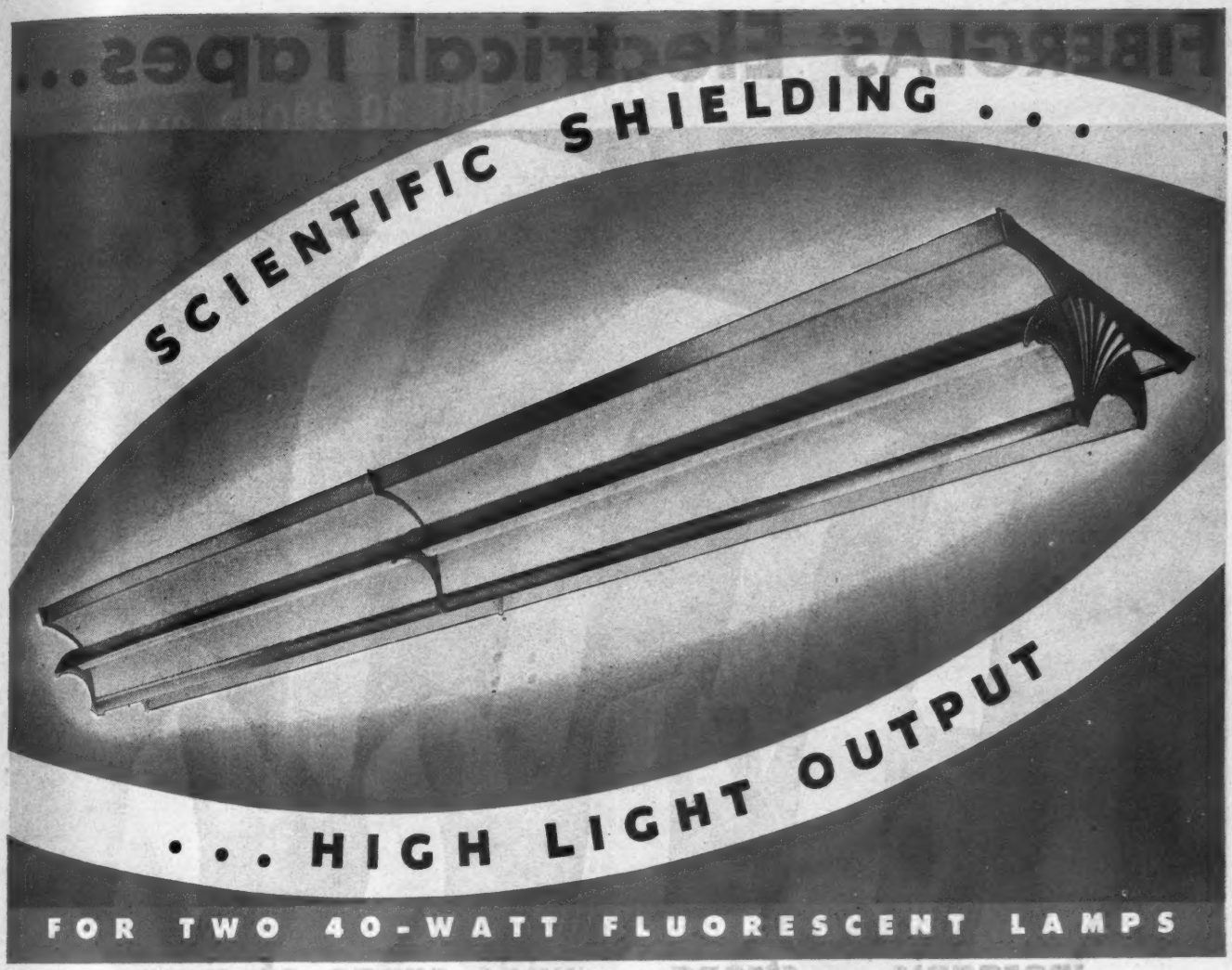
This all means continued business for you —wiring goes right along—porcelain products are in demand. So, as those calls come to you for porcelain, be sure you are prepared with ILLINOIS PORCELAIN.

No vital materials go into the production of porcelain, materials do go into porcelain that make these systems durable—that are not affected by rust or corrosion —that make possible full safety — that make these systems valuable where there is dampness and fire hazard.

Illinois all porcelain wiring systems are adaptable to practically all wiring plans and layouts. They can be installed without grounding.

Illinois ELECTRIC PORCELAIN CO.

MACOMB, ILLINOIS



Curtis SKYLUX

Make your selling job easier by recommending Curtis SkyLux for those two-lamp office installations. Use the good looks of this unit to get your sales story off to a good start. Then follow up with the SkyLux story of high light-delivery, scientific shielding, easy maintenance and long service.

Graceful but sturdy construction characterizes this unit. Reflectors are steel with baked snow-white Fluracite reflecting surface. Shields and moldings are Satin Gray enamel.

The patented SkyLux principle prevents a direct view of the lamp from ordinary angles and at the same time the inner surface of the lamp shield serves as a reflector to direct the light downward. This is accomplished without trapping light, and no horizontal surfaces are present to collect dust.

Write today for our latest SkyLux Folder, Serial 2167.

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6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS

FIBERGLAS* Electrical Tapes...

. . . inorganic . . . strong . . . wide range of sizes . . . can help solve <u>your</u> electrical insulating problems

Many complicated electrical design and repair problems have been solved by the use of Fiberglas Tapes. One of the many advantages is their availability in a wide range of widths and thicknesses.

Fiberglas Tapes are as thin as .003" and as thick as .015", with intermediate thicknesses of .005", .007" and .010"... Standard widths range from ⅜" to 1½".

But, you can also add to this feature the extraordinary tensile strength of Fiberglas Tape! Fiberglas Tape—½" x *.003"*—has an approximate breaking strength of 80 lbs.! Compare this breaking strength with those of *.007" organic tapes!*

Fiberglas Tapes, being glass, have many properties which make them most desirable for use in the insulating of electrical equipment . . . resistance to high temperatures, moisture, oil, corrosive vapors. In combination with suitable varnishes, the result is longer-lasting and more efficient electrical insulation.

Fiberglas is available in all of the standard untreated forms, together with varnished cloth, mica-Fiberglas combinations, varnished sleeving, pressure-sensitive tapes and Fiberglas laminates.

So, whether you manufacture, service, buy or use electrical equipment—Fiberglas is worth knowing about, in every detail.

Fiberglas electrical insulating materials are now IMMEDIATELY AVAILABLE in quantity from distributors' stocks.

When you write for complete information, include a request for your copy of booklet "What Keeps the Wheels Turning" . . . *Owens-Corning Fiberglas Corporation, 1856 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

ARMY E NAVY

FIBERGLAS ...A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

YARNS • TAPES • CORD • SLEEVING • CLOTH AND OTHER FORMS

REPAIR SHOPS OF THE BATTLE FRONTS are wired with WALKER "SYNTHETIC"

Equipment for thousands of these mobile machine shops was installed by THORNTON-FULLER COMPANY of Philadelphia.

Wholesalers supplying WALKER "SYNTHETIC" were: Graybar Electric Company; Elliott Lewis Electrical Company, Inc.; Westinghouse Electric Supply Company.

Each is a self-contained, electrically-powered machine shop, fully equipped to render first aid to disabled mechanized units, and speed them back to the fighting fronts. In all parts of the world, you will find these mobile repair shops, working against time, and enduring hardships second only to those of the fighting machines they serve.

Toughness and efficiency are basic "musts" for every structural part. Machines, generators, and the wiring that carries the electric load must be able to stand up strong and long on a day-and-night shift that never ends. The wiring selected for this important job is WALKER "SYNTHETIC", a noteworthy tribute to WALKER quality and dependability.

WALKER "SYNTHETIC", built to the rigid requirements of war time standards, offers unlimited possibilities for peace time use. It is tough and long-aging . . . highly resistant to heat, cold, oils, alkalies, acids and moisture . . . extremely flexible and easy to handle . . . and it has high dielectric and mechanical strength.

WIRE WITH WALKER

Available in all standard colors—black, white, red, blue, yellow, green—and special shades on order. Sizes range from small diameter building wires up to 4/0.

Ask your Walker distributor for prices and delivery information. Or write to Walker Brothers, Conshohocken, Pa.

WALKER of Conshohocken

Makers of: Rubber-covered, Synthetic and Leaded Wires and Cables * "Walkertex" Non-metallic Sheathed Cables * Service Entrance Cables * Automotive Wires and Cables * Shipboard Cables * Leaded, Non-leaded, Synthetic or Varnished Cambric Insulation * Electric Metallic Tubing * "Dualcote" Rigid Steel Conduit * "Preset-Insert" Underfloor Distribution Systems.

LET THIS UNIT HELP YOU MODERNIZE OFFICE OR DRAFTING ROOM

The Wakefield BEACON is built to standards you'd expect from Wakefield; offers top efficiency, along with lower cost.

A Certified Fleur-O-Lier, the BEACON is designed to combine high quality fluorescent lighting with simple, modern appearance. It's a "honey" for essential office or drafting room. Postwar, it can be a decided help for stores and other commercial interiors.

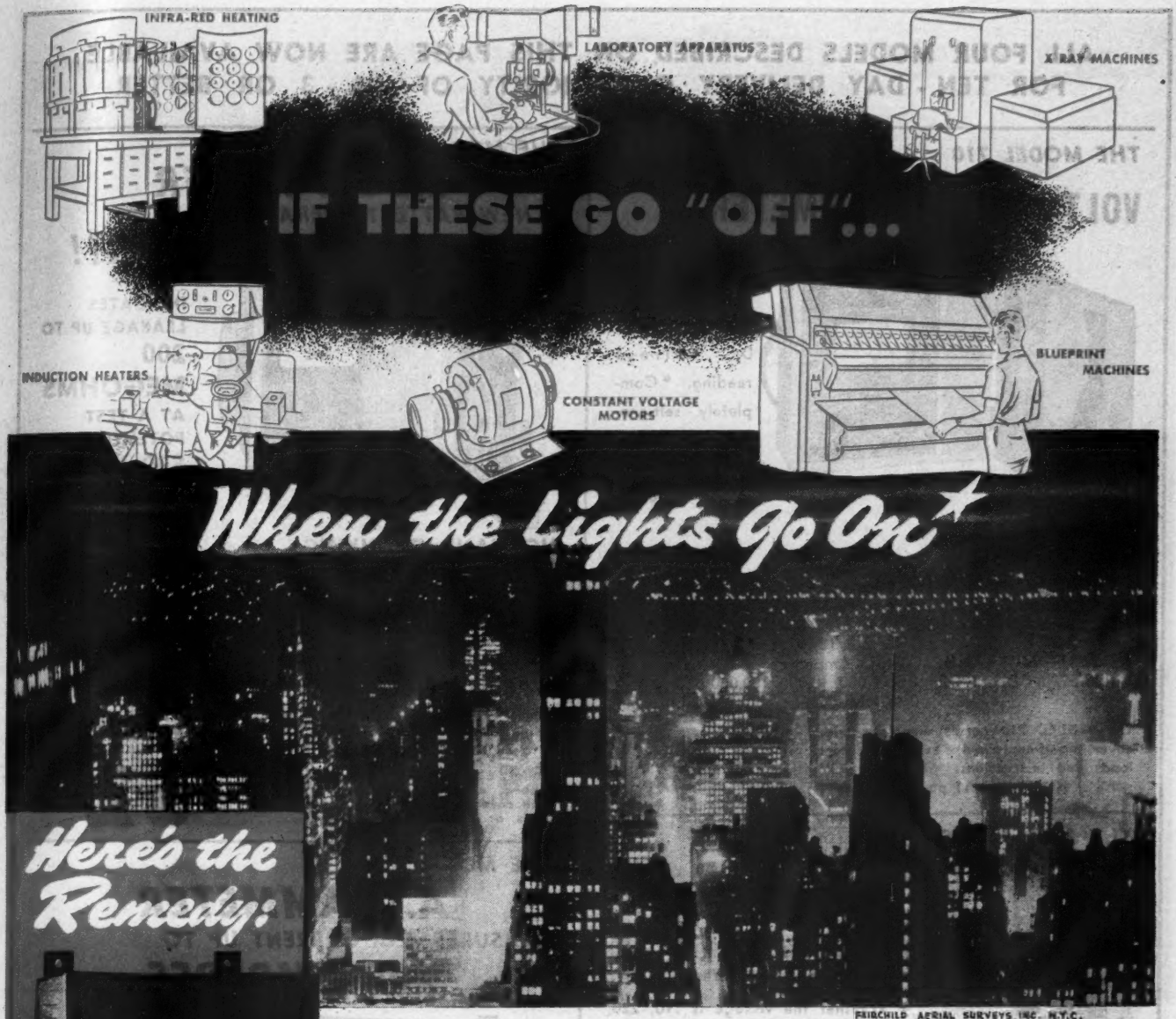
Maintenance is especially easy. There are no horizontal surfaces on which dust can collect. New rigid louvers are hinged to make lamp replacement easy. Has twist-type sockets mounted with slot *up*, so lamps cannot fall out.

Etched, ribbed glass on the side panels gives smooth, diffused light. All-steel construction, finished in infrared bake, cream enamel, with white enamel reflecting surfaces. Pierced metal and caps are backed up with translucent plastic. And you can supply this 4-lamp fluorescent unit in stem suspension as pictured, or with close-up mounting for low-ceiling areas.

Help your customers handle paperwork faster, reduce eye-strain . . . with the BEACON. Get the details now from your Graybar house or write us.

Wakefield

THE F. W. WAKEFIELD BRASS COMPANY • VERMILION, OHIO



FAIRCHILD AERIAL SURVEYS INC. N.Y.C.

Here's the Remedy:

Dips and peaks in line potential need not disturb voltage-sensitive machines and devices. The AmerTran "LC" Transtat Line Voltage Compensators manually correct such fluctuations. They boost or buck voltage as needed. In fact, the "LC" Transtats combine most of the advantages of the famous "TH" Transtats with some that are peculiarly their own.

These advantages include lower cost per KVA of output and close control in increments as low as 0.2 volt without circuit interruption. Air insulated, designed for continuous operation indoors at full load, they are rated from 2 to 85 KVA, for nominal line voltages to 480, adjustment range ± 10% of line voltage. Also available for remote push-button control (LCM). Bulletin 51-2 contains a complete description, ratings, prices and suggested circuits. Write for it.

AMERICAN TRANSFORMER CO.
178 EMMET STREET, NEWARK 5, NEW JERSEY

* Reduces higher than rating line voltages, too. Swelling or sagging voltages are handled with equal ease by "LC" Transtat Line Voltage Compensators.

AMERTRAN

MANUFACTURING SINCE 1901 AT NEWARK N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission

ALL FOUR MODELS DESCRIBED ON THIS PAGE ARE NOW AVAILABLE FOR TEN - DAY DELIVERY ON PRIORITY OF AA - 3 OR BETTER

THE MODEL 710

VOLT-OHM-MILLIAMMETER

* Sensitivity 1,000 ohms per volt on both A.C. and D.C. * Direct reading. * Completely self-contained. * No external source of current required.

SPECIFICATIONS:

6 D.C. VOLTAGE RANGES: 0 to 15/60/150/300/600/1500 Volts
6 A.C. VOLTAGE RANGES: 0 to 15/60/150/300/600/1500 Volts
7 D.C. CURRENT RANGES: 0 to 3/15/50/150 Milliamperes
0 to 3/15/30 Amperes
A.C. CURRENT RANGE: 0 to 3 Amperes
5 RESISTANCE RANGES: 0 to 1,000/10,000/100,000 ohms
0 to 1 Megohm 0 to 10 Megohms

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net Weight 11 pounds. Price.. **$34.50**

THE NEW MODEL 590

VOLTAGE TESTER

Reads Like A Thermometer ! ! Automatically Indicates—

- Whether the voltage is 110, 220, 440 or 660 Volts.
- If the current is A.C. or D.C.
- If the appliance, motor, etc., connected in the line is "open".
- Which leg is "grounded".
- If the frequency is 25 or 60 cycles.
- If the fuse is "blown".
- When one side of an appliance or motor connected to the line under test is "grounded".
- Excessive leakage between a motor and a line.
- When a three phase motor is running erratically due to "blown" fuse.

No meter, No switching, No tip jacks. To use: simply connect the needle pointed test prods across any line and this truly versatile instrument will instantly indicate the Voltage, frequency, type of Current, etc. Rugged, dependable and efficient, this amazing electric tester measures only 1¾" x 5" x 1⅝" and weighs only 5 ounces. Unlike most electrical testing instruments which necessarily require a great amount of care, the Model 590 is designed for "bang around" maintenance work, and yet due to the unique design it compares favorably in sensitivity with expensive metered instruments in that it draws less than 1 Milliampere of current.

MODEL 590 comes housed in a beautiful hand-rubbed, wooden cabinet. Panel is of etched steel. Shipping weight 2 pounds. Complete with instructions. Only **$5.85**

THE MODEL 610-B

MEG-O-METER

A NEW BATTERY-OPERATED

INSULATION TESTER!!

INDICATES LEAKAGE UP TO 200 MEGOHMS AT A TEST POTENTIAL OF 500 VOLTS D.C.

NO HAND CRANKING:

The 500 Volt Test Potential is made instantly available by throwing the front panel toggle switch.

DIRECT READING:

All calibrations printed in large easy-to-read type enabling exact determination of leakages from 0 to 200 Megohms.

3 RESISTANCE RANGES:

In addition to the 0 to 200 Megohm Range which is used for insulation testing, two additional lower ranges are provided, 0 to 20,000 Ohms and 0 to 2 Megohms.

Model 610-B comes housed in hand-rubbed, rugged Oak Cabinet, complete with cover, self-contained batteries, test leads and instructions. Only..... **$62.50**

THE MODEL 720

A.C. AMMETER

MEASURES A.C. CURRENT UP TO

200 AMPERES

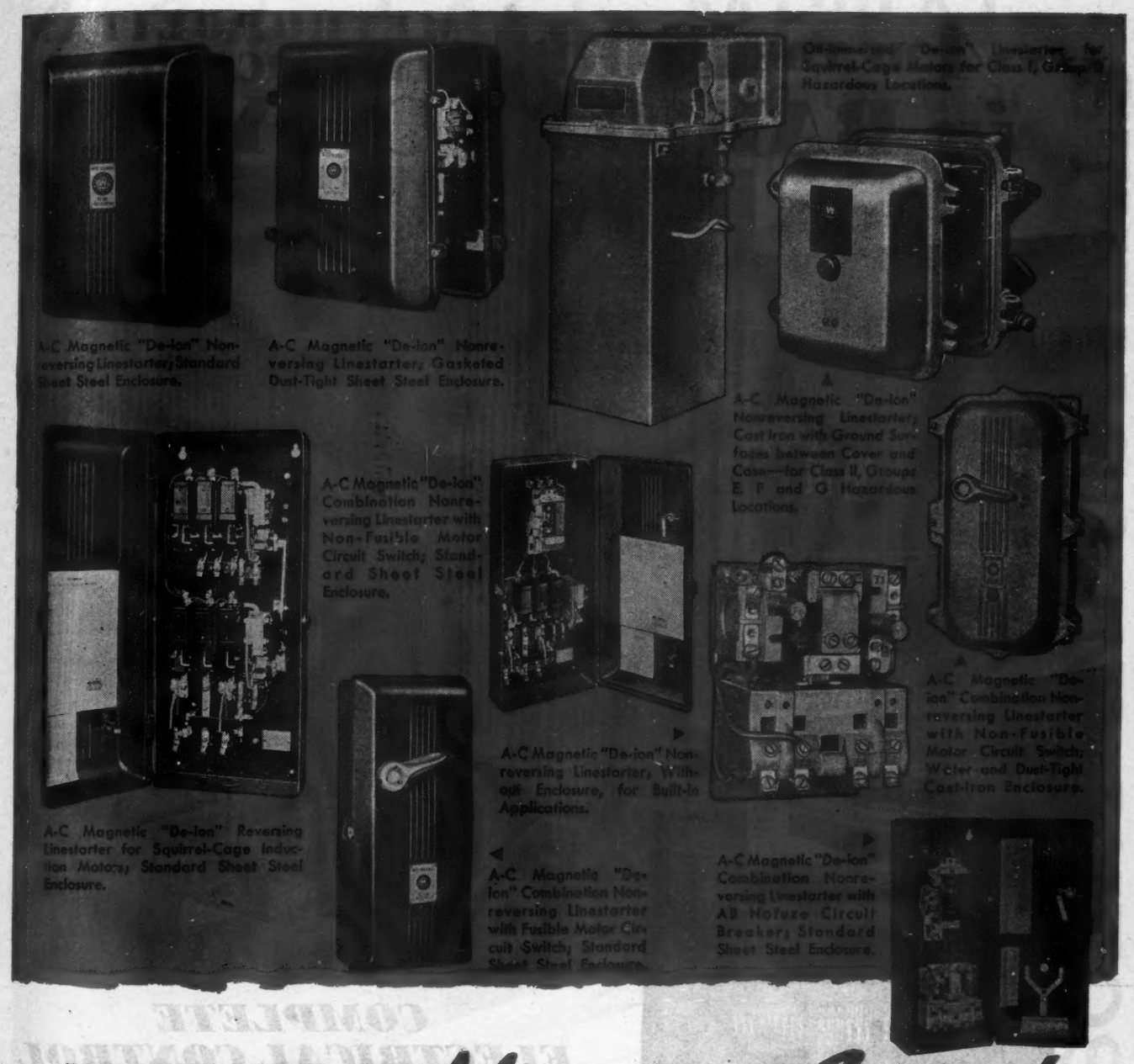
4 RANGES: 0 to 10/50/100/200 Amperes

The Model 720 combines the two most efficient methods of measuring A.C. Current. Heavy-duty binding posts on front panel used for measuring low currents to 50 Amperes. Built-in toroid transformer permits measurement of currents up to 200 Amperes without breaking line. Necessary only to insert either leg of the line through front panel core opening.

Model 720 comes housed in heavy-duty, leatherette covered cabinet, complete with cover and instructions. Size 13" x 7" x 4½". Price..... **$49.50**

SUPERIOR INSTRUMENTS CO.

Dept. E.C., 227 Fulton Street **New York 7, New York**



A-C Magnetic "De-ion" Nonreversing Linestarter; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Nonreversing Linestarter; Gasketed Dust-Tight Sheet Steel Enclosure.

Oil-Immersed "De-ion" Linestarter for Squirrel-Cage Motors for Class I, Group D Hazardous Locations.

A-C Magnetic "De-ion" Nonreversing Linestarter; Cast Iron with Ground Surfaces between Cover and Case—for Class II, Groups E, F and G Hazardous Locations.

A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Non-Fusible Motor Circuit Switch; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Reversing Linestarter for Squirrel-Cage Induction Motors; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Nonreversing Linestarter; Without Enclosure, for Built-In Applications.

A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Fusible Motor Circuit Switch; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Combination Nonreversing Linestarter with AB Nofuze Circuit Breaker; Standard Sheet Steel Enclosure.

A-C Magnetic "De-ion" Combination Nonreversing Linestarter with Non-Fusible Motor Circuit Switch; Water- and Dust-Tight Cast-Iron Enclosure.

WHEN YOU NEED *Magnetic Controls*

FOR SINGLE-PHASE AND SQUIRREL-CAGE MOTORS CONSULT WESTINGHOUSE BUYING DATA (NEW CATALOG 7000)

With the new Westinghouse Buying Data, you can select and purchase the proper motor control in half the time.

Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any published previously by any manufacturer.

Chances are—if you are a buyer of motors and controls—that you have already received a copy of this new Catalog 7000 by mail. However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office. (Requests will be filled through district offices only — no mailing from Westinghouse headquarters at East Pittsburgh.) J-60552

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

De-ion Linestarters

★★★★4 OF THE 1008 METROPOLITAN ELECTRICAL UNITS *in* RADIO CITY

COMPLETE ELECTRICAL CONTROL by

At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

Knife Switchboards
Circuit Breaker Switchboards
Dead Front Switchboards
Battery Charging Switchboards
Motor Control Switchboards
Explosion-proof Switchboards
Laboratory and Test Switchboards
Control Switchboards
Generator and Distribution Switchboards

METROPOLITAN ELECTRIC MFG. CO.

ESTABLISHED 1892
METROPOLITAN
TRADE MARK
ELECTRIC LIGHTING AND POWER DISTRIBUTION EQUIPMENT

GENERAL OFFICES: LONG ISLAND CITY, N. Y. FACTORIES: LONG ISLAND CITY, N. Y., & WEST WARREN, MASS.

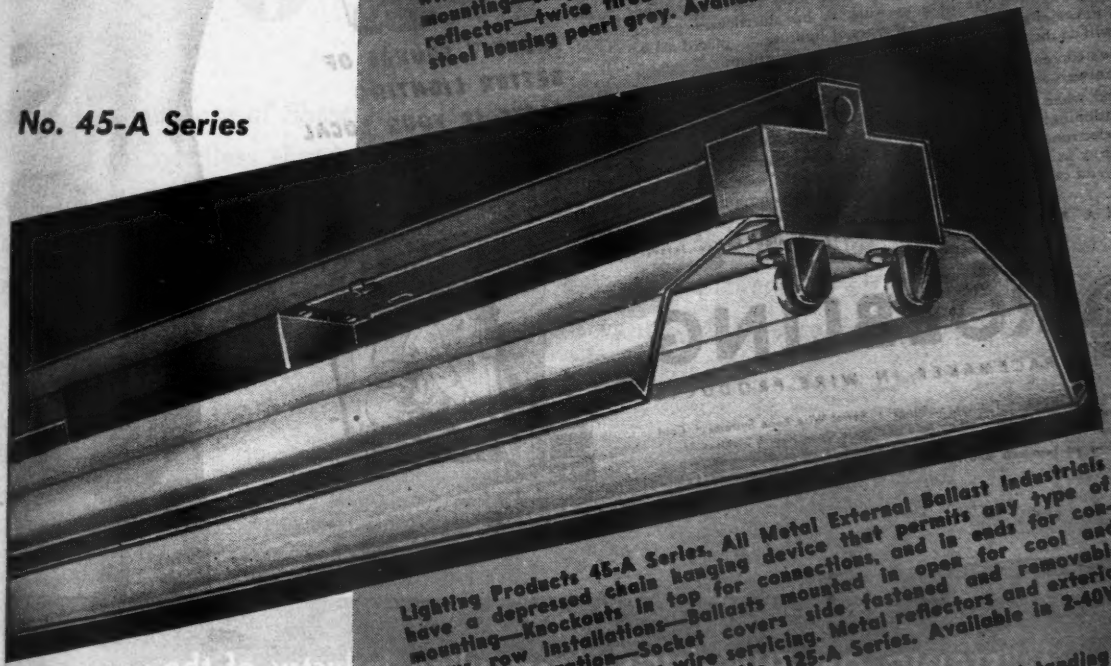
All Featured ALL METAL • FLUORESCENT INDUSTRIALS •

for either conventional or instant start lighting . . . . .

No. 125-A Series

Lighting Products 125-A Series, All Metal Enclosed Ballast Industrials incorporate all labor saving installation and maintenance features. Other features are drop ends for socket protection—starter changing without lamp removal—K.O.'s in ends for pull switches and continuous mounting—simple to install for any type of hanging. Finish inside of reflector—twice fired white enamel; exterior of reflector and all steel housing pearl gray. Available in 2-40W, 3-40W, and 2-100W units.

No. 45-A Series



Lighting Products 45-A Series, All Metal External Ballast Industrials have a depressed chain hanging device that permits any type of mounting—Knockouts in top for connections, and in ends for continuous row installations—Ballasts mounted in ends for cool and efficient operation—Socket covers side fastened and removable channel covers for easy wire servicing. Metal reflectors and exterior of units finished the same as No. 125-A Series. Available in 2-40W, 3-40W, 4-40W and 2-100W units.

Send today for complete information on this new outstanding Metal Line.

LIGHTING PRODUCTS INCORPORATED

HIGHLAND PARK, ILLINOIS . . . . . U.S.A.

Why Jim Broke His Leg!

Postwar lighting will keep thousands of "Jims" from accidents caused by inadequately lighted floors and machinery. Jim won't trip over an obstruction that's properly illuminated — and color coded to catch his eye.

Skillful combination of incandescent, mercury vapor and fluorescent lighting—plus color code safety painting—will do much to reduce industrial accidents — and increase manhour output.

In readying your plant for stiff, peacetime operation, be sure to consider Better Lighting.

THERE'S A MAN on your staff who draws *no* salary—yet is always willing to consult with you. He's your local power company's lighting engineer. He likes to work in his shirtsleeves—getting down to cases as to exactly *what* types of lighting . . . placed *where* . . . will do the *most effective* lighting jobs in your plant.

He's concentrated on this problem for many years—has most of the answers at his finger tips. Why not tap his knowledge *now?*

And when the time comes to install better, safer lighting, air conditioning, improved power distribution methods, the electric and electronic cost-cutters evolved during the war . . . remember Roebling as wire specialists—your logical, single source of all the wires and cables required in your modernization program.

JOHN A. ROEBLING'S SONS COMPANY, Trenton 2, New Jersey

Branches and Warehouses in Principal Cities

FASTEST SOURCE OF BETTER LIGHTING FACTS IS YOUR LOCAL POWER COMPANY

ROEBLING

PACEMAKER IN WIRE PRODUCTS

Wire Rope and Strand • Fittings • Slings • Aerial Wire Rope Systems • Cold Rolled Strip • High and Low Carbon Acid and Basic Open Hearth Steels • Round and Shaped Wire • Electrical Wires and Cables • Wire Cloth and Netting Aircord, Swaged Terminals and Assemblies • Suspension Bridges and Cables

LIKE A "STRING ON THE FINGER" reminding industry of the advantages of postwar Electronics . . . Better Lighting, Air Conditioning, Full Utilization of War-Developed Electrical Devices . . . this Roebling campaign will aid Electrical Contractors.

TO SAFEGUARD

is also the purpose of Shawmut THERM-A-TRIPS. They protect motors, circuits, and equipment. They avoid needless shutdowns. Their long, safe time-lag allows motors to start and run on normal overloads; but they blow at once on excessive overloads and short circuits. They occupy a small space, are inexpensive, need no attention, can be instantly replaced; and no other overload protection is needed. Three types: knife-blade, ferrule, and plug. Protection with THERM-A-TRIPS is positive protection — the kind you want. Make sure you specify them.

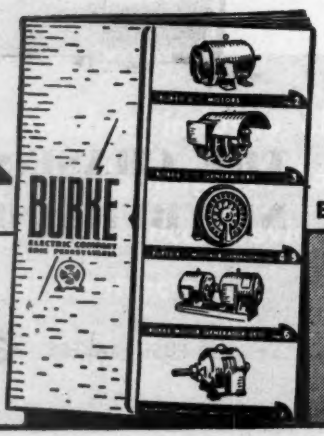
THE CHASE-SHAWMUT COMPANY
NEWBURYPORT, MASSACHUSETTS

FUSE MAKERS SINCE 1893

What can BURKE do for Me?

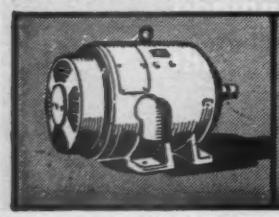
HERE'S a quick look at Burke Products to answer the headline question. When you examine each booklet, more specific questions will develop, questions that Burke engineers will be glad to answer.

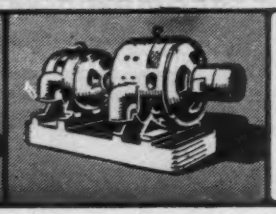
You may be surprised to learn that Burke pioneered and perfected the Universal Motor and the 3-Wire D. C. Generator, that Burke introduced the high cycle Motor Generator Set for powering High-speed Tools, and that Burke was first to use electric welding construction. In order to have you know Burke better we will be glad to send you a complete set of these Burke Bulletins.



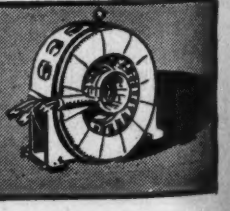
⇨ ⇨ For quick reference to the Burke line, see Sweet's Catalog File and Electrical Buyers' Reference Catalog.

BURKE ELECTRIC COMPANY • 1201 WEST 12TH STREET ERIE, PENNSYLVANIA





D.C. Equipment to 1500 H.P. and 1000 K.W.
A.C. Equipment to 1500 H.P. and 1000 K.W.
M-G Sets to 1000 K.W.
Molded Bakelite Terminal Blocks

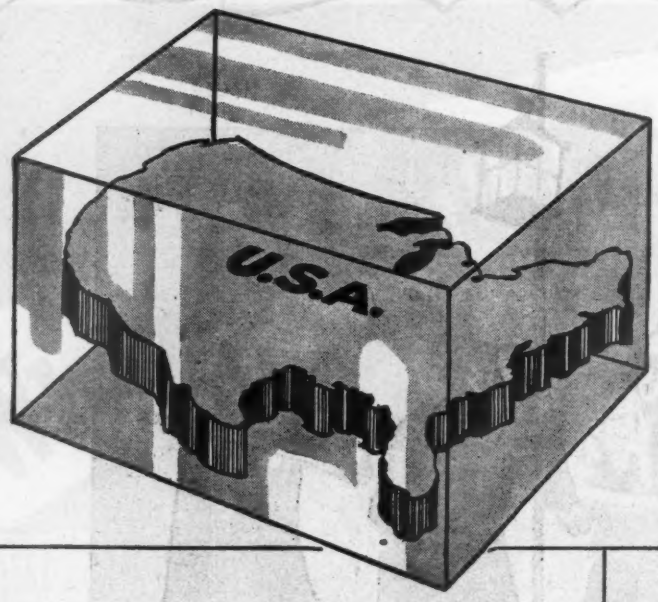


SPANG-CHALFANT

Division of The National Supply Company

Executive Offices: Grant Building, Pittsburgh, Pa.

District Offices and Sales Representatives in Principal Cities



The Rittenhouse Consumer Survey

IN THREE DIMENSIONS

FOR the first time in the history of door chimes merchandising, Rittenhouse has removed the guess-work and generalities from the consumer-buying picture.

The Rittenhouse Consumer Survey now nearing completion is the first conclusive survey, national in scope, to cover all economic and buying factors bearing upon the sale of electric door chimes.

NATIONAL IN SCOPE

97 skilled marketing investigators *personally interviewed* a cross section of householders in 36 states (including 129 key trading areas and their adjoining communities), representing every geographical division of the country.

DIMENSIONS OF SURVEY

Some idea of the dimensions of the survey may be gotten from the following group factors covered in the investigation:

- ★ Large, medium and small size cities.
- ★ Those income groups forming the largest segment of the national chimes market.
- ★ Individuals living in *houses* and *apartments*.
- ★ Householders who *did* and *did not* own chimes.
- ★ *Owners* and *renters* of houses.
- ★ All age groups.

INFORMATION IS BASIC

The type of information assembled and the technique employed to obtain it was in keeping with the most modern practices of present day marketing research methods. The information thus derived is of basic, practical character and has been proven the direct efficient low-cost way to the successful promotion of a specialty product.

The findings of the three-phase survey, which began in May, will be published in the form of a bound integrated report, available to all wholesalers and dealers about January 1945.

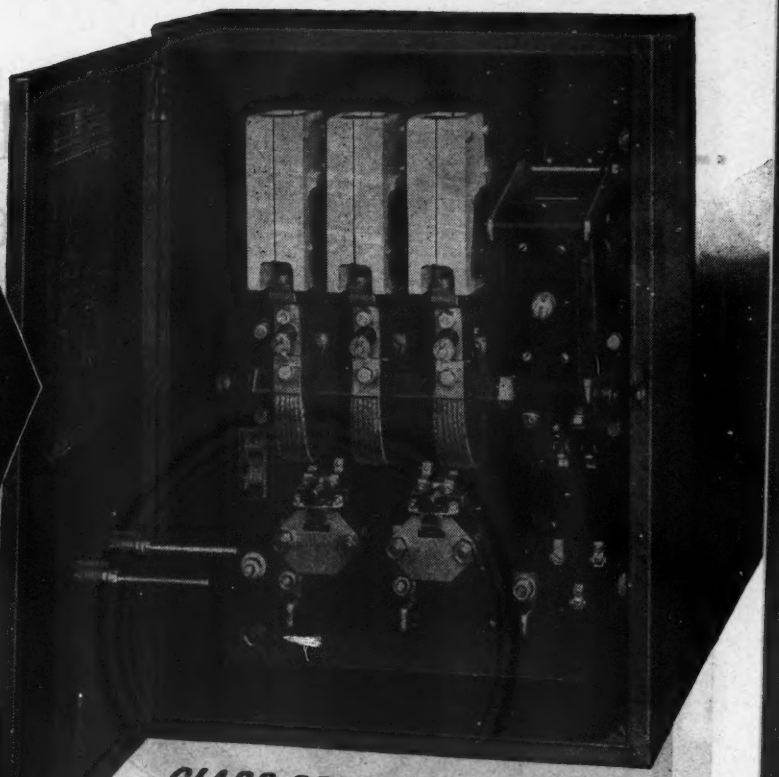
VISIT OUR EXHIBIT · CHICAGO HOUSEWARES SHOW
PALMER HOUSE, ROOM 971 · JANUARY 7th TO 12th

Rittenhouse

Tomorrow's Better Door Chimes

The A. E. Rittenhouse Company, Inc., *Honeoye Falls, N. Y.*

AN *Improved* SIZE 4 STARTER WITH FIVE NEW FEATURES



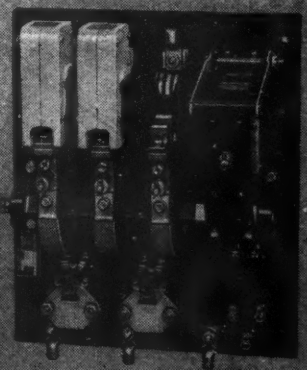
CLASS 8536 · TYPE VG-2

---SMALLER-QUIETER---

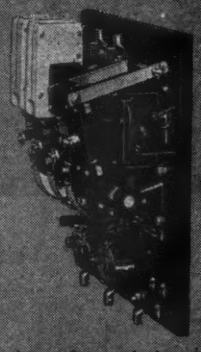
1. Improved blow-out coils have fewer turns and are wound with heavier copper—assuring less heating effect, and efficient interruption of stalled rotor currents for electric motors up to 100 horsepower.
2. New and larger magnet of modified "E" type construction gives added efficiency.
3. Self-aligning, floating armature eliminates vibration noise—reduces heating and magnet wear.
4. New shading coil affords exceptional mechanical strength. This coil is held in place by the magnet coil in such a manner as to prevent its falling out. Use of heavy brass ribbon makes shading coil virtually unbreakable.
5. Narrower panel saves space and flat door cabinet permits gang mounting.

• • •

This greatly improved Type V device is available in a complete range of enclosures for all Size 4 starter applications, including reversing, combination, multi-speed, reduced voltage, etc. Call in or write your nearest Square D Field Engineer for complete information.



Open type starter panel with one arc chute removed to reveal contacts and blowout coil.



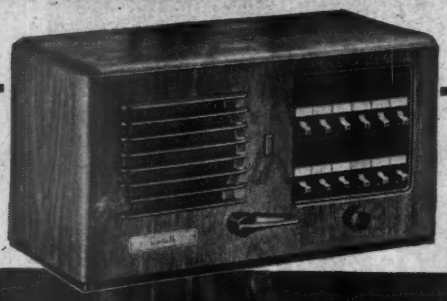
Side view of panel shows "E" type magnet, floating armature and new shading coil.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Teletalk Saves Over 10 Miles of Walking Daily

BY EMPLOYES OF MURRAY IRON WORKS



FROM THE MURRAY IRON WORKS FOUNDRY, GROVER C. DIDERIKSEN (ABOVE) TALKS WITH KENNETH A. METH (BELOW) IN THE OFFICE 675 FEET AWAY.

(X) INDICATES APPROXIMATE LOCATION OF TELETALK UNITS . . .

From fifty to 100 trips a day are saved between the office of the Murray Iron Works, Burlington, Iowa, and their 600 foot-long foundry by the use of Teletalk Amplified Intercommunication.

"We find Teletalk of great value in our production set-up, saving the valuable time of our employes," says Edward R. Denz, plant superintendent, as he talked of the many quarter-mile trips that are saved every day.

In every community electrical contractors find many plants and offices whose executives are quick to see the advantages of plugging up the leaks caused by inefficient order dispatching systems. They are finding quick profits in showing how Teletalk can enable them to easily and conveniently keep in touch with every department.

There is a Teletalk System to meet all needs, of either the block-long plant or the two-suite office. Easy to install. Takes its power from the electric light circuit. Time and energy saved through the use of Teletalk allows every business man to accomplish more . . . pays for Teletalk in a comparatively short time.

If you are not now selling Teletalk, find out about this modern, efficient method of inter-office communication at once. Make Teletalk a "must" in your plans for post-war business.

Let's All Back the Attack

Buy Extra War Bonds

WEBSTER ELECTRIC

Teletalk

REG. U.S. PAT. OFFICE

WEBSTER ELECTRIC COMPANY, Racine, Wisconsin, U.S.A. Established 1909. Export Dept.: 13 E. 40th Street, New York (16), N. Y. Cable Address: "ARLAB", New York City

WEBSTER ELECTRIC

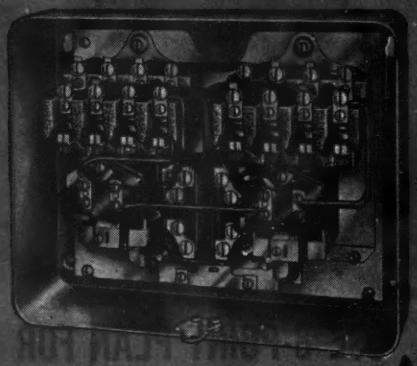
"Where Quality is a Responsibility and Fair Dealing an Obligation"

Federal

INDUSTRIAL CONTROLS

engineered to *outlast* the equipment they control

Don't be surprised if the Federal controls you buy for one machine *outlasts* two, three or even four others. For—Federal builds 'em for long life. Designs them to withstand the rigors of hard usage. To take in stride shocks . . . vibrations — or what have you. Expect to find, too, ample wiring space . . . easily removable contacts . . . efficient operation . . . ease and economy in maintenance. For safe and dependable control of motor-driven machinery depend on Federal.



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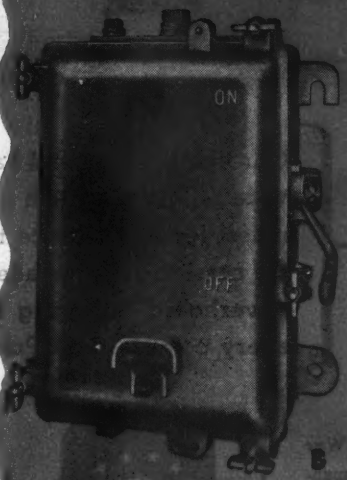


B

A. Reversing magnetic starter Type "A" sheet steel cabinet

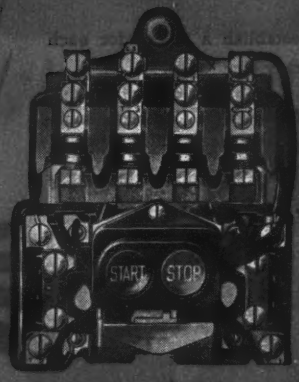
B. Combination motor starter Type "D" weatherproof cabinet

C. Manual Motor starter Type "A" sheet steel cabinet

D. Magnetic Motor starters Type "U"—inside only

E. Push button station

C



D

E

FEDERAL ELECTRIC PRODUCTS COMPANY

Plants at: 1429 Park Street, Hartford, Connecticut and 50 Paris Street, Newark, New Jersey

They're Going Overboard For Victory—Are YOU?

USE 8-POINT PLAN FOR AN OVERBOARD DRIVE IN THE 6th WAR LOAN!

NOV. 20th TO DEC. 16th

Our fighting men still have a long way to go! But—your plant-wide selling of the 6th can do much to shorten their embattled miles—lessen the price they so willingly pay for victory! Join the coast to coast parade of patriotic firms that are assuring an "overboard" showing in the 6th by following through on every point in the 8-Point Plan.

Start the ball rolling by appointing a **6th War Loan Bond Committee**, representing labor, management and other groups.

Carry on by selecting a **Team Captain**—preferably a returned veteran—for every 10 workers.

Right at the start, establish a **Quota** for each department—and every employee.

Arrange frequent **Meetings of Captains**, highlighting importance of their work—effective sales methods—and need for painstaking study of Treasury Booklet, Getting The Order.

Make definite **Assignments** to those best equipped to arrange music, speeches, rallies, competitive progress boards and meeting schedules.

Issue **Individual Pledge Cards**—made out in the name of each worker and providing for both cash and installment purchase.

Resolicit! This is the secret of "overboard" War Bond subscriptions. Your State Payroll Chairman has a special Resolicitation Plan for you to put into action near the end of the campaign.

Give generously of your **Advertising Space** to drive home the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

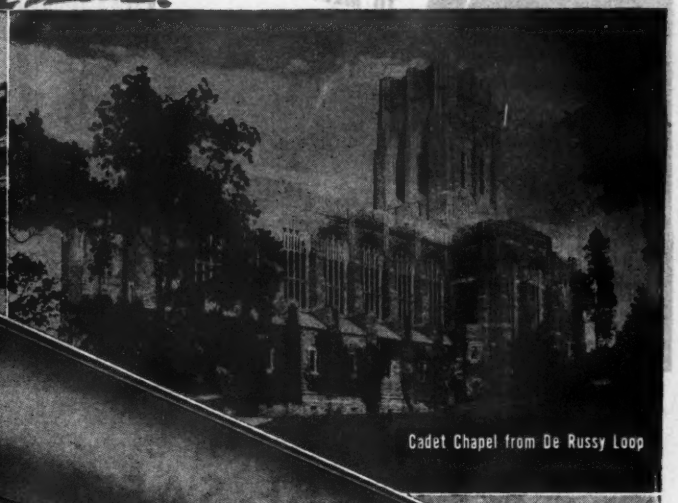
ELECTRICAL CONTRACTING

★ *This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council* ★

Saluting the GUTH *CADET

*** THE FLUORESCENT LIGHTING FIXTURE INSTALLED IN THE UNITED STATES MILITARY ACADEMY AT WEST POINT**

Cadets marching to Guard Mount



Cadet Chapel from De Russy Loop

The GUTH CADET

West Point from the Air

Colors during Battalion Parade

West Point Cadets Study by the Light of GUTH "Cadets"

THE study-areas at West Point Military Academy are now lighted by the Guth CADET the new semi-indirect type luminaire.

Forty-five Foot-Candles of uniform, glare-free, shadowless lighting is delivered on the study-desks. The illumination is evenly distributed throughout the area; there are no "Bright-spots"—all brightnesses are correlated. Reading visibility is excellent; writing with either pen or pencil is now effected without any direct or reflected glare. A 100% perfect *seeing-light* has been provided!

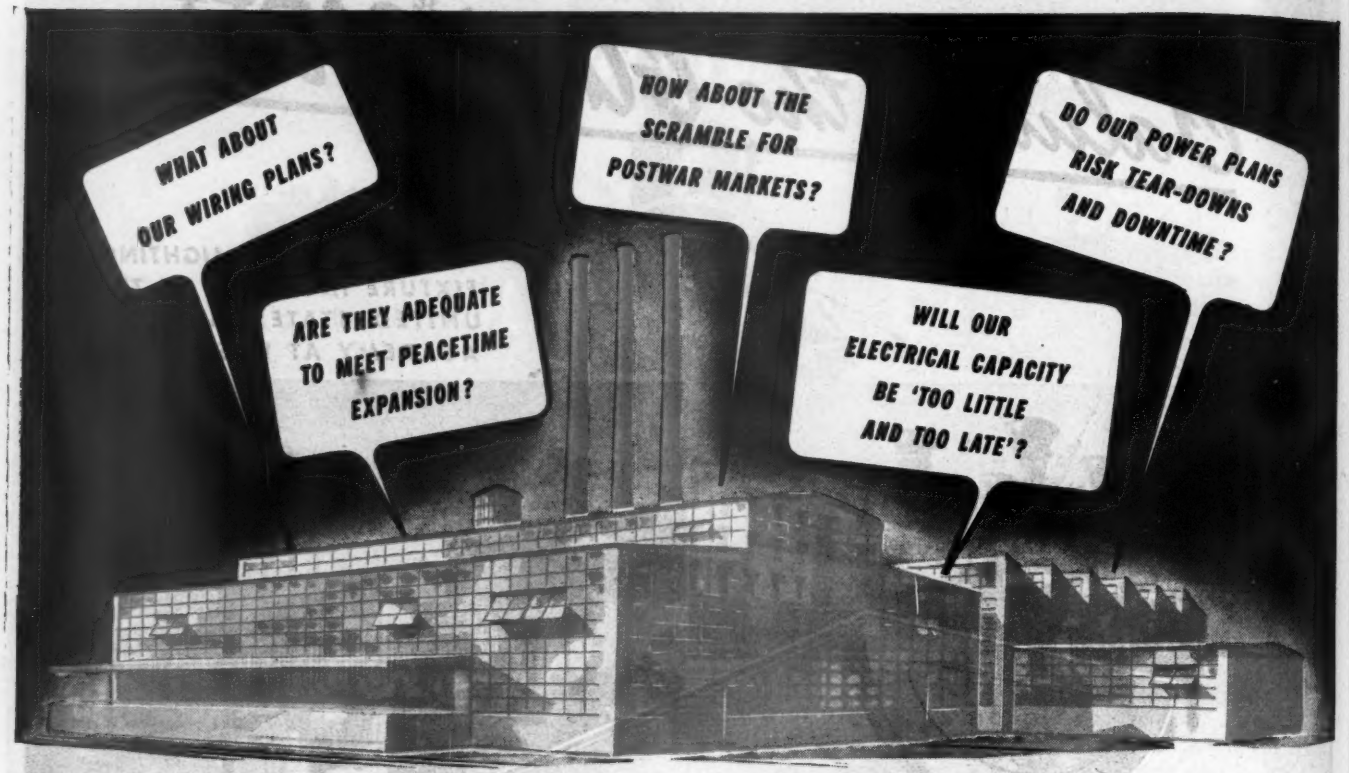
The new Guth CADET semi-indirect luminaire, is *now* Commercially available. Write for details.

THE EDWIN F. GUTH COMPANY
2615 Washington Ave.
ST. LOUIS 3, MO.

LIKE THE WEST POINT CADET, THE GUTH CADET IS

Smart in Appearance *Efficient in Action* *Developed for Precision* *Dependable in Service*

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.


WHAT ABOUT OUR WIRING PLANS?
HOW ABOUT THE SCRAMBLE FOR POSTWAR MARKETS?
DO OUR POWER PLANS RISK TEAR-DOWNS AND DOWNTIME?
ARE THEY ADEQUATE TO MEET PEACETIME EXPANSION?
WILL OUR ELECTRICAL CAPACITY BE 'TOO LITTLE AND TOO LATE'?

BE SAFE – BE CERTAIN

Wire Ahead!

If the facts below make sense, check up on your wiring plans *now!*

FUTURE MARKETS

Foresighted market surveys won't mean much if plant wiring and service equipment capacity don't back up potential volume.

NEW DEVICES

Do your plans anticipate the huge increase in the use of electricity—the power demands of new, complex electrical machines?

COSTLY TEAR-DOWNS

Figure the expense of possible downtime and labor costs for emergency wiring and equipment.

OBSOLESCENCE

What about your banker? He'll want to be sure that electrical efficiency is adequate to keep your plant a prime commercial risk.

POSTWAR EMPLOYMENT

You'll want to help assure places for the horde of returning men. Don't let inadequate wiring cramp your personnel.

Obviously unwired planning will cost a lot more than planned wiring. Wire Ahead! Have a talk with your electrical contractor, power engineer or utility power engineer. 44351-A

ANACONDA

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

Well-Planned Power is Future Selling Power—Wire Ahead!

INTERDEPENDENCE

We don't know our own strength. If the full force of the electrical industry could be thrown behind just one program, it would bring a new electrical age over night.

When Hitler made his final plans for war, he looked at the United States and analyzed its weaknesses accurately. Divided by political strife, by individualistic ambitions, by idealistic ignorance of the world's ills, it was a pushover. Its strength was overlooked. It was in the blood of pioneers who had to lay aside personal differences to fight off hostile Indians. It was in the temper of a people who carved a great nation out of a wilderness. It was in the genius of men who created the world's greatest industrial empire. His error is easy to understand. We didn't know it ourselves.

If we stop to analyze the possibilities of creating an electrical age after the war, we are tempted to use our pre-war industry pattern as a starting point, and the weaknesses stand out.

The characteristics of individualism, divided efforts and group rivalries evident in the nation, were even more pronounced in the electrical industry.

The industry lacked a real sense of its interdependence. It had little understanding of its full power. We have a better foundation today. The war has taught us how to mobilize resources. And the idea of bringing the full weight of the electrical industry behind the task of creating an electrical age is far from fantastic. It is, in fact, a very practical objective.

Last month the National Electrical Manufacturers Association brought forth a resolution called the Declaration of Electrical Interdependence. It called upon the members to "recognize their common cause for national progress into the Electrical Age, that all recognize the factor of electrical interdependence between branches within our industry, that all will henceforth be ardent supporters of the electrical idea to the end that this Declaration of Electrical Interdependence shall become a living document in honor of our pioneers and in trust for the welfare of those who follow."

This can be the beginning of a postwar mobilization of industry resources. But the sense of interdependence must reach beyond the executive, the sales manager and the engineer. It must reach into the shop and out on the job, through the rank and file of the millions of people now working in the electrical industry. The sense of obligation for industry progress must be as acute in the mind of the mechanic as it is in the plans of his boss.

And the great force of a mobilized industry loyal to its manifest destiny, can be built only by the courageous leadership of men willing to accept the principle of interdependence.

Wm. T. Stuart

Electrical Contracting

DECEMBER, 1944

SO THAT 40,000 BUILDING PLANNERS WILL KNOW YOU BETTER

The December issue of Architectual Forum carries the Graybar advertisement reproduced here, so that more than 40,000 architects and building leaders will better understand the many ways they can use your services.

It stresses the advantages of calling you in while plans are still in the formative stage. To help you do a better job of meeting builders requirements, your local Graybar Man is ready with the latest in supplies and application aid.

WHEN THE WORD COMES TO START CONSTRUCTION . . .

John Watts
Electrical Contractor

CAN HELP SPEED YOUR PLANS INTO ACTION!

When the word comes to start construction, you'll want to cut through all the time-consuming preliminaries as never before. John Watts, the qualified electrical contractor, can help you do it, particularly if you get his assistance well in advance.

In drawing up electrical specifications, John Watts can relieve you of the details of catalog-hunting for scores of the minor items which must go together on the job. It's his business to have details on new devices and materials, and to know the code regulations which affect their use. With his help, causes of construction delay can be anticipated and avoided in advance.

After the war, problems of building electrification will be more complex than ever — and you'll need the help of a competent firm of electrical specialists more than ever. Why not establish your electrical-contractor contacts more firmly right now — and let them work with you to "clear the decks" for action!

5533

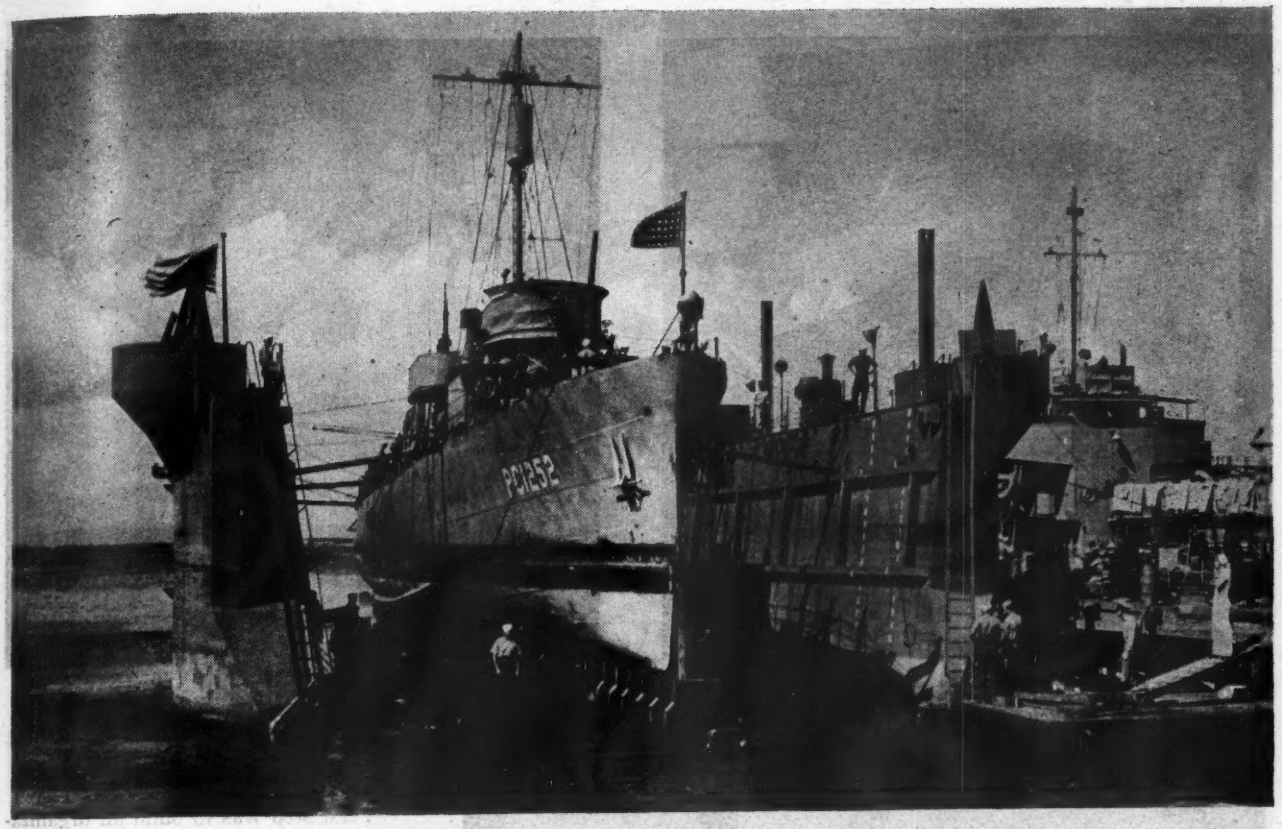
Give Your Electrical Work to "John Watts"
a qualified electrical contractor — heading a well-established firm with the trained organization, tools and know-how to give you specialized assistance on wiring, lighting, signaling, power supply, electronics. From offices and warehouses in over 80 cities, GRAYBAR serves a nation of JOHN WATTS, helping them to help you by supplying the newest and best in electrical materials.

GraybaR

Executive Offices: Graybar Building, New York 17, N. Y.

OVER 75 YEARS OF Electrical Distribution

ADEQUATE WIRING THE KEY TO THE HOME OF TOMORROW



A R D, auxiliary repair docks follow the fleet.

Wiring SEAGOING DRYDOCKS

Auxiliary drydocks are electrified repair shops. They follow the fleet, and speedily restore damaged craft to action. This is the story of an electrical construction organization developed to wire A R D's and the kind of wiring and apparatus installed.

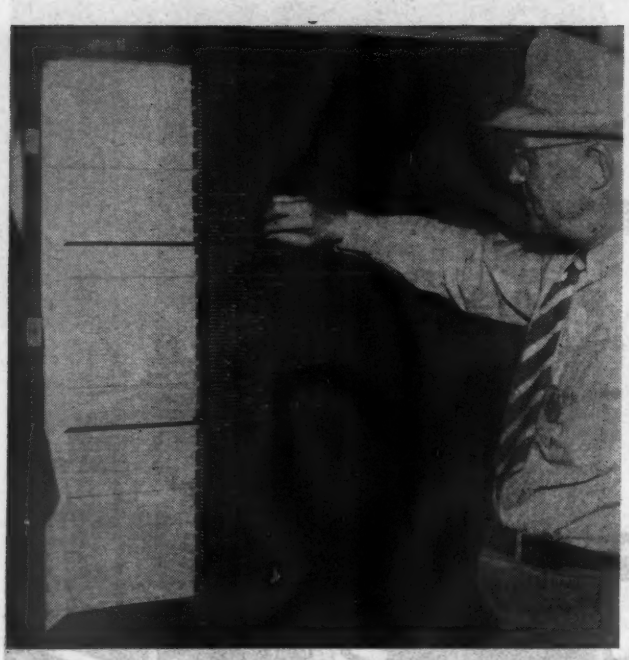
By W. A. Cyr

IF the U. S. Navy has come through in remarkably brief time to carry the war right to the enemy, one of the facilities which make this possible is the floating repair base, the auxiliary repair dock. And if the Navy has made a great number of these mobile bases, from which to operate at short range against the enemy, it is because contractors have proved their ability to deliver them in "impossibly short time."

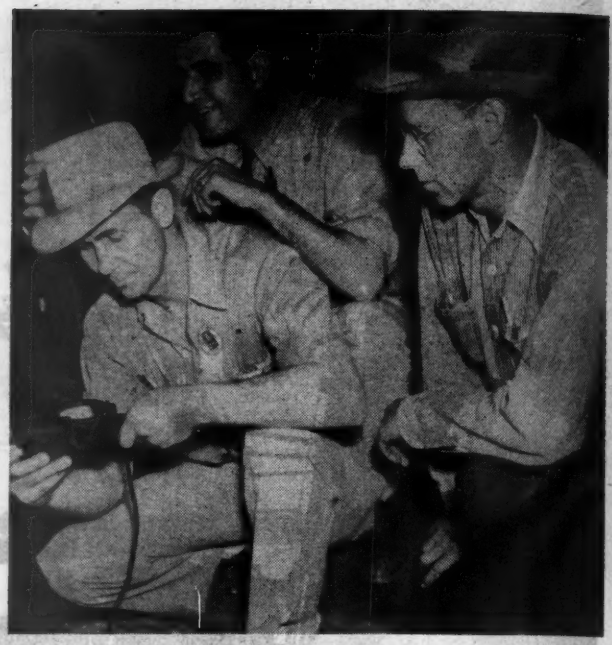
The electrical contract, which Abbett Electric Co., of San Francisco, has just completed for Pacific Bridge Co., prime contractor, was one of the war's largest electrical contracts, totalling over $5,000,000. It was a lump sum contract on a renegotiation basis, something unusual for this type of project. It called not only for ability to deliver a constantly increased number of these floating drydocks large enough to accommodate a destroyer or light cruiser, in decreased time for each one, but resulted in getting them at less cost progressively.

Initially it drew on all the engineering brains, the practical installation experience and the ability to mobilize men and materials and direct them to a finished product which proves the value of employing such "know how" when a job is to be done fast, economically and skillfully. Before the war the Navy had but one floating drydock. Consequently in developing this type a great many practical details had to be engineered and developed as the work progressed. The contractor maintained an engineering staff who worked closely with the Pacific Bridge Co.'s engineers in the layout of cable and feeder systems, placing of the equipment, and in refinements of detail.

Among the things which the contractor had to develop was a system for handling cables, provision for doubling the feeders and the electrical capacity of the original docks built, and engineering of a water level control system through which the pumps for partially submerging, refloating and leveling of the repair dock are remotely operated



***SCHEDULE vs. JOB** progress on each operation is marked. T. R. Roach, personnel manager, shows how.*



***SUPERVISORY STAFF,** electrical superintendent Jack Cimino, assistant Bill Hicks and foreman Victor Lasson.*

***MATERIALS FOR EACH COMPARTMENT** are assembled and boxed at the main warehouse ready for delivery to the job.*

***MATERIALS ARE PREPARED,** cable cut, boxes attached, panels and supporting frames assembled in this prefabrication shop.*

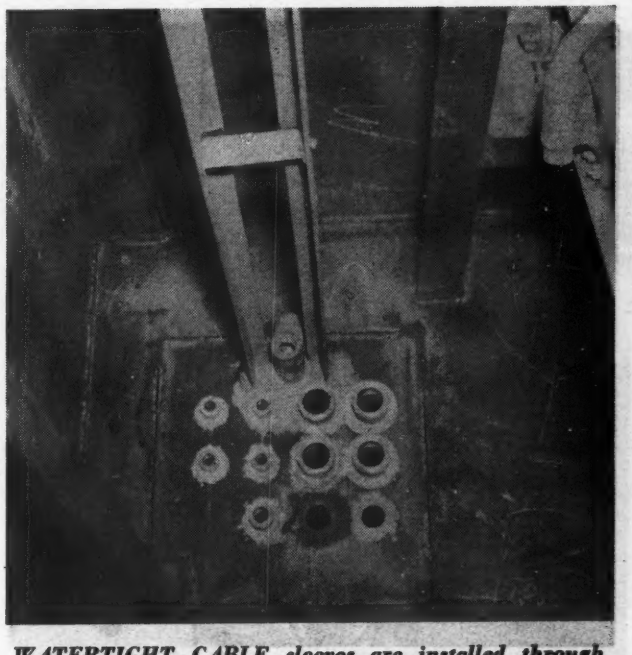
from a special pilot house.

First step was to build an organization. For so large a project George Abbett's own organization was augmented through arrangements to loan from Severin Electric Co. a superintendent, Jack Cimino, and an assistant superintendent, Paul de Pietro. Another assistant superintendent, Bill Hicks, shared the responsibilities for running the job on each of the usual four docks which were under construction at one time. At the peak, manpower consisted of 260 men and women, distributed in office, shop, warehouse and working on the vessels themselves.

The contractor established both a large office and a shop and warehouse at the Alameda yard. As much equipment as possible was prefabricated ready to be installed. As a rule four docks were being built progressively, while two were being outfitted. Supplies were well organized. A material delivery system was set up and charted for each dock under construction. A large wooden box containing all the materials for each compartment of each dock was prepared in advance, numbered for that compartment and for the dock. Boxes were painted in different colors, representing the different sides of the dock and thus delivery to the job was expedited.

In the office an elaborate system of charting the progress of each drydock during the progress of the work was maintained. Material control and dispatching contributed to a smooth flow of materials. Graphic charts were

STUD GUN WELDS threaded studs for cable hangers and fixture supports in place on layout marks.



WATERTIGHT CABLE sleeves are installed through watertight bulkheads for cable runs.

ANGLE IRON FRAMES for supporting and racking cables are welded in place.

PRE-CUT CABLES are installed and connected to equipment terminals at junction boxes.

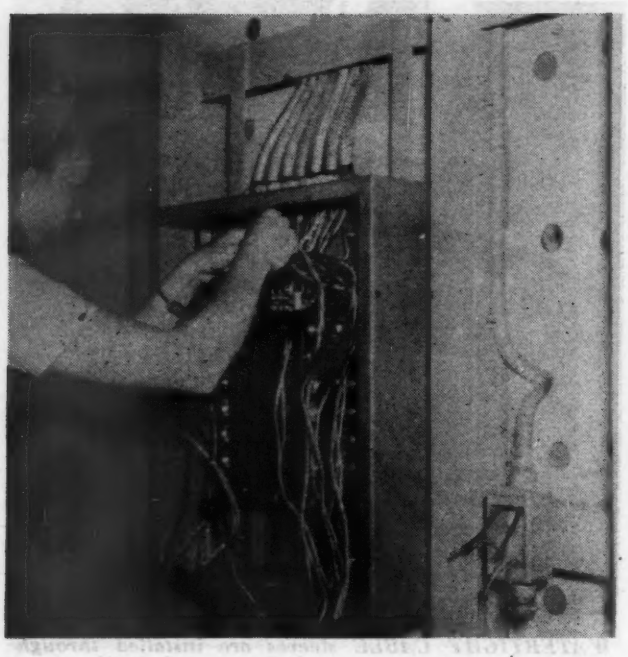
maintained which gave a visual indication of the progress of each portion of the work in relation to the schedule. The original contract, let in 1940, was for two drydocks with a time allotment of 237 days. The final one took only 61 days and during the peak period the ARDs were turned out approximately two weeks apart in a continuous line.

Power Plant

Containing a power plant and electrical equipment to make it completely independent of land supply, each ARD of this class contains a power battery of three 210-kw. and one 100-kw. diesel-electric generators driven by 375-hp. and 150-hp. diesel engines, respectively. Generation is at 440 volts, three-phase, and the power goes through a main switchboard for distribution to panels and switchgear serving all lighting and power. Lighting is served at 230/115 volt, single-phase, and all power at 440 volt, three-phase. Transformers are of the dry type and there are twelve 5-kw., three 7.5-kw., six 37.5-kw. and six 25-kw. transformers per dock.

A main bus circles the entire dock. Originally this called for one three-conductor, 500,000-cir. mil cable. This was later doubled. To make use of shore power where available, connection can be made through an incoming shore feeder to a 500-amp. breaker at either side of the dock. The backbone of distribution centers around this straight tie across amidship of the dock, fed by 500,000-cir. mil cables in 6-in. conduit between panels and disconnecting breakers. Reverse current relays are used to protect this line against backfeed, either from shore power or the dock's own plant.

While under repair a ship can be fed from the dock's power supply main switchboard through ship service



***BOX SUPPORTS** are welded in place, panels installed and circuits connected by separate crews.*

***SIGNAL AND CONTROL** cables are connected to terminal strips in signal distribution cabinets.*

transformers. These consist of two banks of 220-volt, three-phase, and two banks of 110-volt, three-phase transformers. Provision is also made for 125/250-volt d-c for submarines and ships using direct current. This comes from a separate 100-kw. motor-generator set. Three of the docks were supplied with mercury rectifiers instead of motor-generator sets. These are 187-kw. ignitron rectifiers and were the first to be used for this purpose.

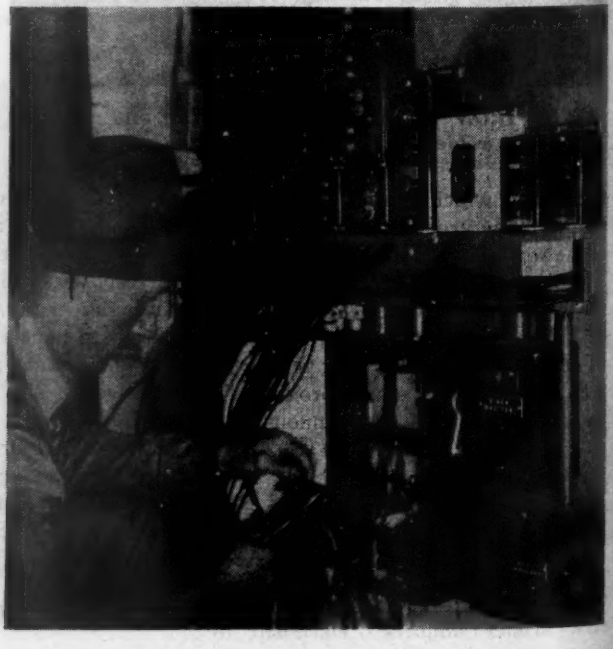
Ingenuity was called for on the part of the contractor to take care of the multitude of cables in the restricted space. Marine cable of the shielded type was used, ranging in size from 500,000 cir. mil down to 2,828 cir. mil, and with some conductors having as high as 44 in a cable. The contractor needed to devise a new method for racking such cable. In a regular pan type of construction the available space would have been insufficient. The entire bulkhead would have had to be used in some places and this would interfere with other equipment.

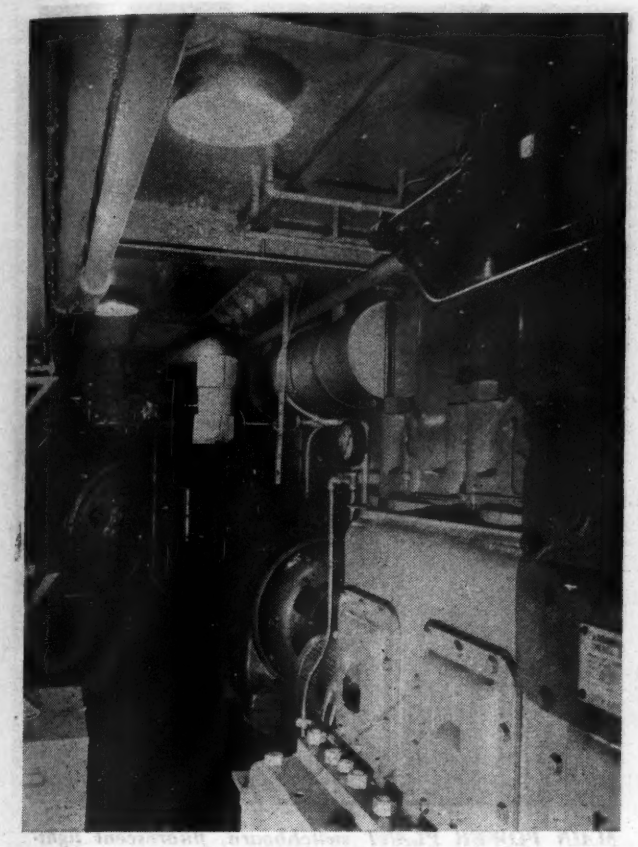
The contractor built cable racks in tiers. In some places these are of five decks high and carry, in addition to the electrical cables, copper tubing for the water level indicator system. Such racks are used to carry the cables to the valves, the main feeders and the various power cables, and separate racks are provided for communication systems cables.

Strap iron, welded to an angle iron frame, which itself is supported from the deck by welded straps, make up these racks. Fixtures and individual short runs of lighting or power cable on the skin or deck of the ship, are affixed to threaded studs which have been previously welded to the steel

***READY-WIRED** heavy motor control panels are lowered into compartments for final installation.*

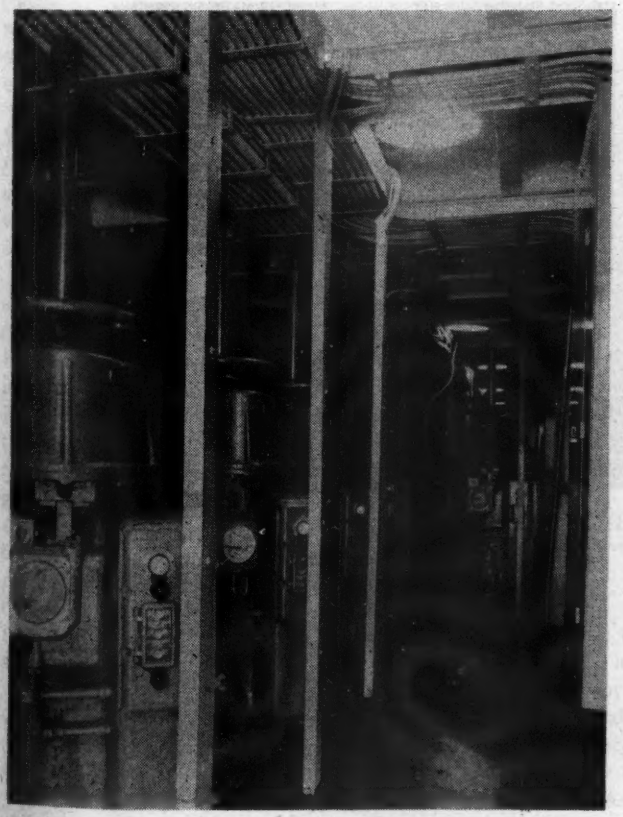
***CONTROL BUTTONS** are assembled around convenient wiring troughs for control circuits.*



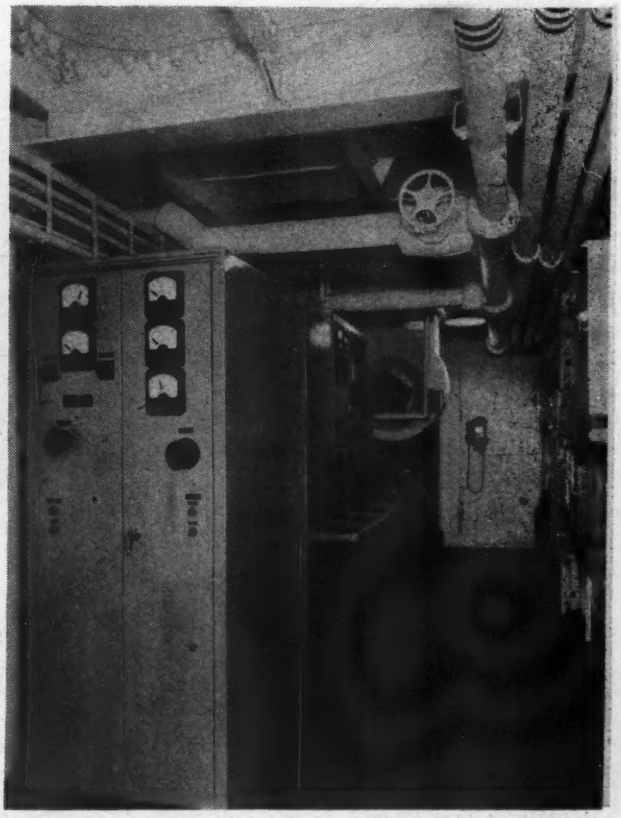


MAIN POWER PLANT has two diesel engine driven 210 kw. generators and one 100 kw. set.

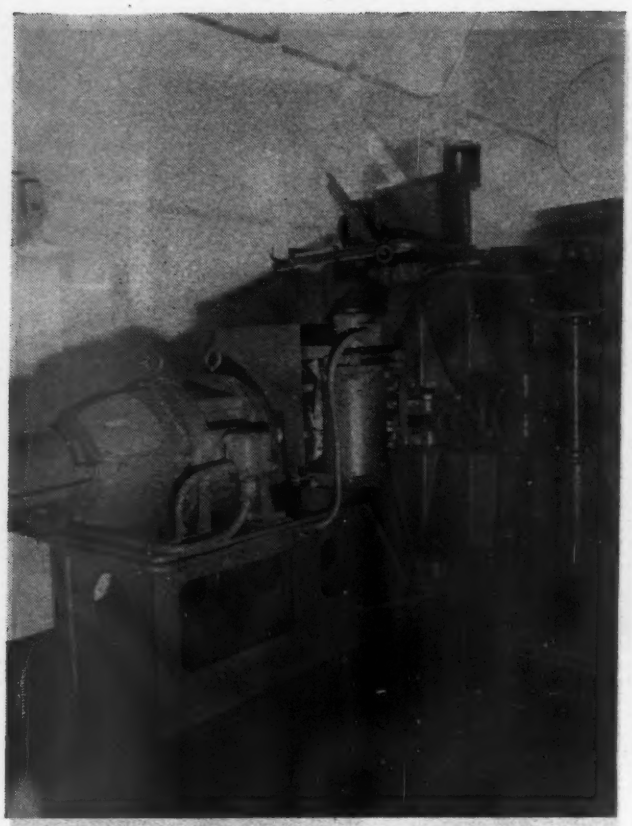
TWO 750 AMP. welding generators are driven by a single motor. Control panels are in the rear.



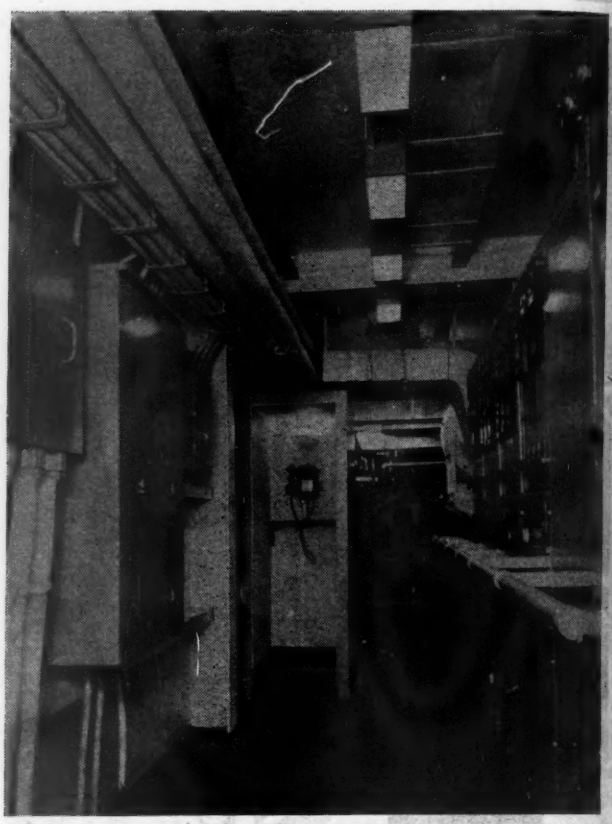
CABLE RACKS over electrically driven valves. Circuit serving each valve is brought down in welded channel.



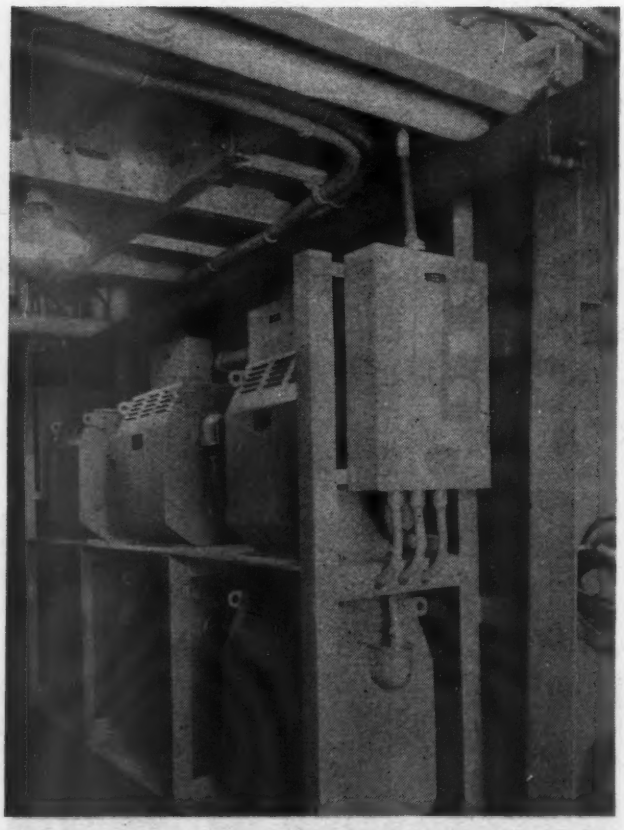
SHIP SERVICE d. c. power is provided by generator operated from enclosed control panels in foreground.



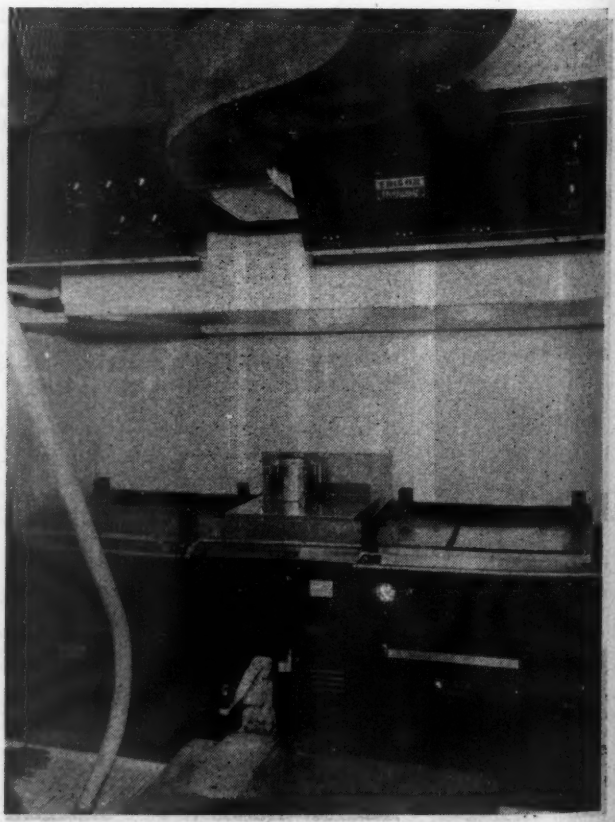
***HYDRAULIC** steering apparatus is controlled by Selsyns providing precise and easy operation.*



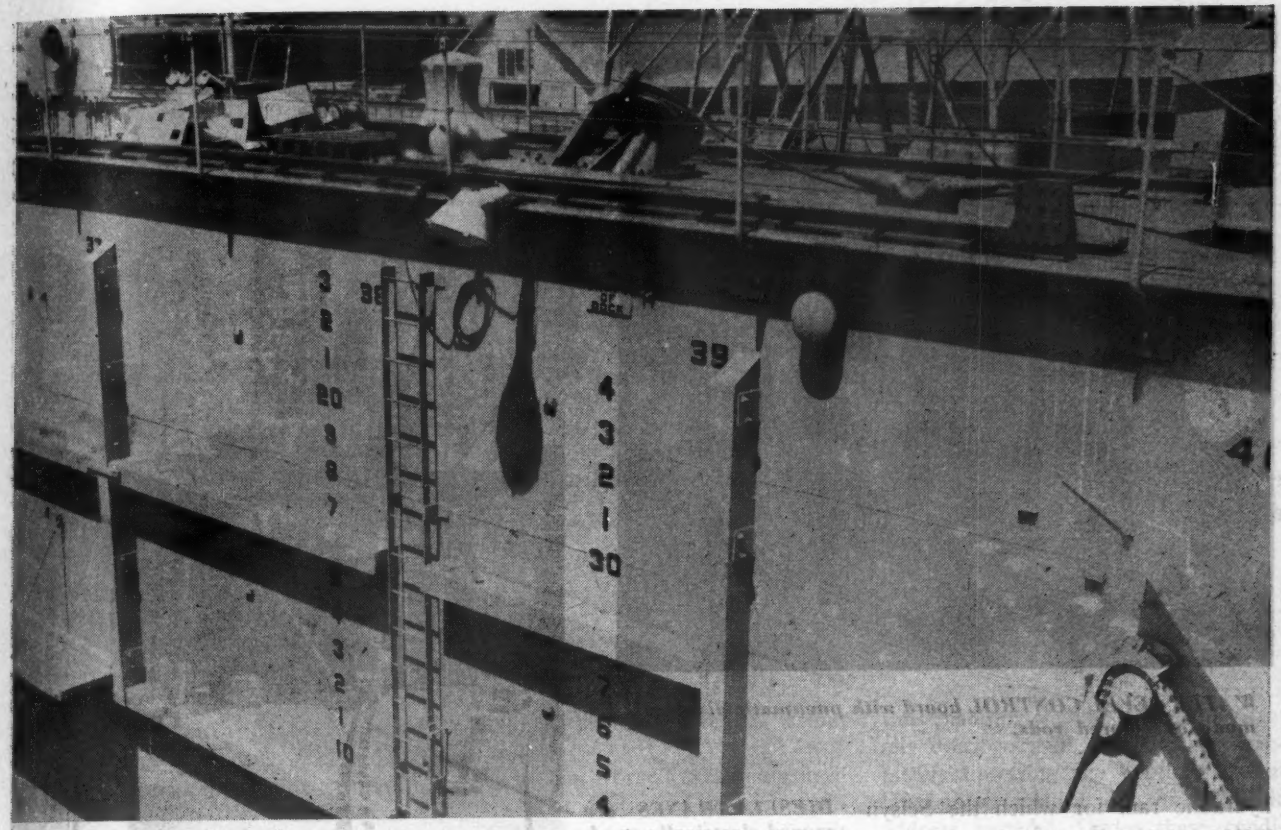
***MAIN POWER PLANT** switchboard, fluorescent lighting above, light and power panels at left.*



***TRANSFORMER BANKS** are installed on welded steel racks designed for easy maintenance.*



***GALLEY EQUIPMENT** is compact and all-electric of special design. Controls are overhead.*



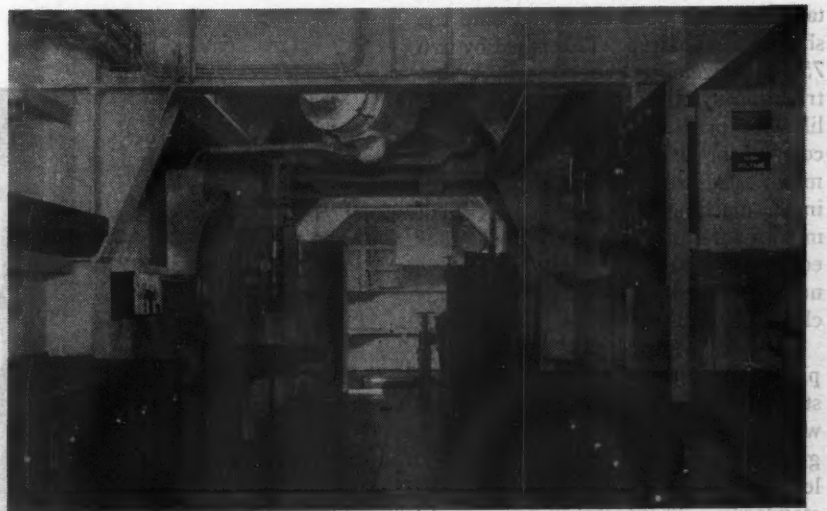
***FLOODLIGHTING OUTLETS** are located under the rail at the top of the ship basin. Floodlights can be installed at deck level or on tall standards.*

plates. The area around these studs was painted in advance to permit installation before the general painting of the ship.

Dock operating equipment required 38 electrically operated valves for flooding of the submersion chambers and four 75-hp. pumps to exhaust this water and raise the dock. There are also two 50-hp. fire pumps.

A special feature is the water level control system developed by the contractor. A pneumatically controlled Foxboro type of system of indicating instruments is mounted on two boards in a special control house just below the main pilot house on the boat deck, amidships and forward. This room gives a clear view of the dock interior, so that the operator can watch the operations of mooring and leveling and remotely can control the pumps to trim the dock as required. If a ship lists the dock can be adjusted to admit it and handle it to better advantage.

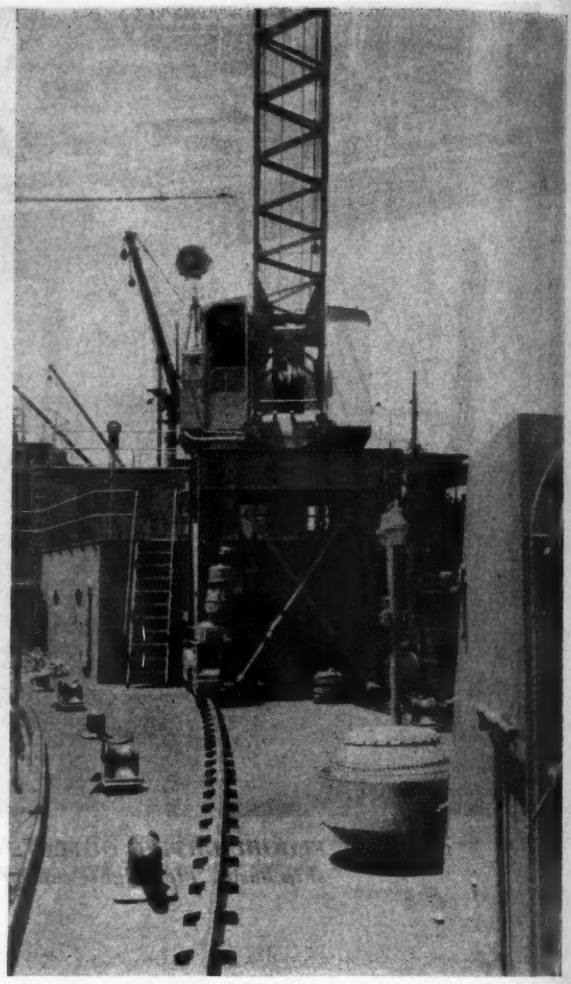
These control boards are equipped with a pneumatic system which has compensating lines and a manual purging system, fed compressed air by a 5-cu-ft. compressor driven by a ¾-hp. motor. One board is for each side of the vessel. Each board gives visual indication of all the tanks and lines leading to them, and has pushbuttons and pilot lights for remote operation of all pumps and valves. The complete submergence operation, usually handled on board by the electricians, can be done by one man. Visual indicators and levels for trimming are mounted on these boards likewise.



***ELECTRIC SHOP** has bake oven for motor repair, drill press, compact testing equipment and ample bench space.*

The end gate is electrically operated also with synchro-tie for equal operation of the chain on both sides of the basin. Steering of the dock under tow is also electrically controlled through a Selsyn generator at the steering wheel with appropriate receivers at the rudder location. The rudder itself is operated by means of a 200-lb. pressure

WATER LEVEL CONTROL board with pneumatic diagrams made of colored rods.



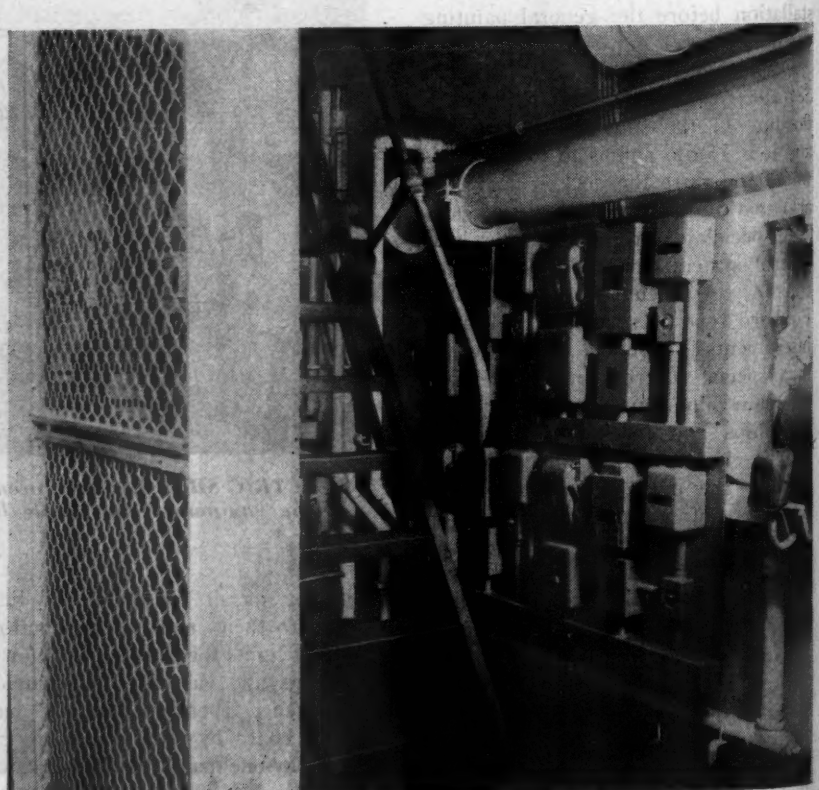
DIESEL CRANES are moved electrically straddling deck equipment.

hydraulic ram for which the Selsyn motor operates the valve.

Other electrical equipment of interest is a distribution system of welding feeders, with fourteen 200-amp. outlets equally distributed around the dock and from which leads can be taken into the dock basin and onto the ship being repaired. This is fed by two 750-amp. welding generators. A distribution system for compressed air is likewise provided, fed by 125-hp. air compressor driven by a synchronous motor. Motor-driven machine tools in the machine shop and various small motors for fans, ventilators and other equipment are supplied. There are numerous mooring winches and anchor chain capstans.

Lighting for the dock basin is supplied by means of twelve portable standards which accommodate 1,500-watt floodlights. These can be plugged in by means of a light cord to outlets adjacent to the socket for the standards. These floodlights can be mounted either at deck level or up on the standards. At the same location are provided some three-phase, 440-volt outlets for tar pots, and there are twelve circuits for portable tools accessible inside the basin.

The docks also contain standard signal and communication equipment, telephone, public address, searchlights, running lights, etc. The galley is completely electrically equipped and there is an electrician's shop on board fully equipped to make electrical repairs.



CONTROL ASSEMBLY for refrigeration compressors serving cold lockers.

P.A. Integrates PLANT OPERATIONS

How sound engineers at the North American Aviation, Inc., Dallas, Texas plant won the battle of paging vs. noise with a high power public address system

By August Eckel

PAGING in the average manufacturing plant has always been somewhat of a problem due to the varying intensities of noise accompanying the production processes. In the modern aircraft plant, with certain departments reaching maximum decibel values, the problem assumes the aspect of the impossible.

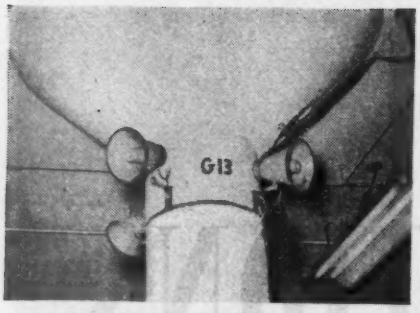
Such was the situation confronting the sound engineers at the Texas Division of North American Aviation, Inc., Dallas, when they started planning a public address system in January, 1942. Completed in November of that year, it was designed primarily to broadcast air raid, evacuation, "stop" and "go back to work" signals as well as paging plant executives. Now the revised and expanded system is also being operated during lunch and rest periods to bring newscasts and recorded music programs to employees.

The original system in Plant A, installed at the time when the AT-6 Texan trainer was the only plane built in their single plant, was designed to fit the then existing problems and was planned backward from speaker to amplifier. After determining (with noise meters) the decibel (DB) value of noise levels in each plant department at full operation, the engineers calculated the amount of power needed to overcome each area noise level and chose the type of horn or speaker needed for each specific area.

Under this system, 275 re-entrant, expotential-type horns with a frequency response of from 100 to 9,000 cycles per second were installed in the factory area. Here, where the battle of sound waxed hottest, the horns were mounted on the lower truss of the roof, approximately 14 feet above the floor level and aimed to cover given areas. A total of 22 amplifiers, delivering an overall output of 1,540 watts with less than five percent distortion, powered the 275 horns. The offices were equipped with 77, six-inch, permanent magnet type speakers mounted in walnut cabinets.

The system worked excellently until expanded production of the now famous P-51 Mustang (at that time built only at the California Division) led to the assembly of both the AT-6 and the P-51 under the same roof in the Texas plant. Thousands of additional employees were hired. Departments of the original plant were relocated thus changing the noise levels of virtually every area of the plant and completely upsetting the carefully calculated power requirements of the public address system. Under these conditions the efficiency of the system suffered and the ultimate outcome was to discourage future pursuance of the system's design keynote: the individual noise level method of powering and aiming horns to cover a given area.

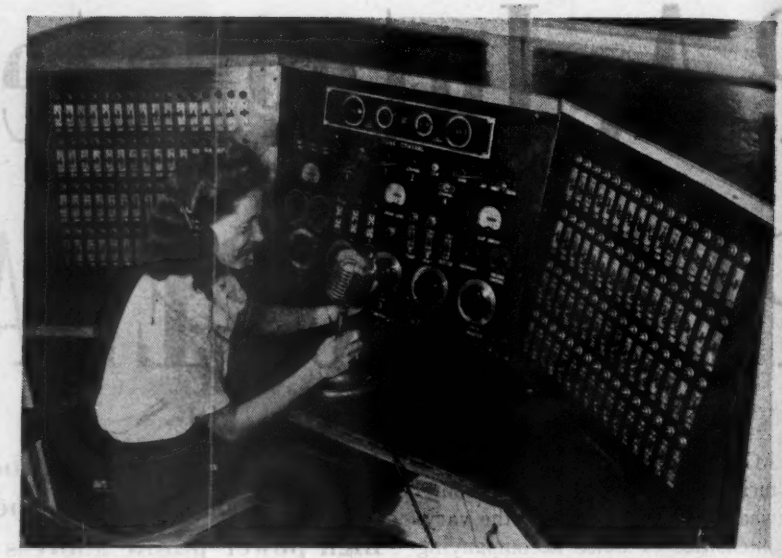
BANK OF AMPLIFIERS, some of the 116 units powering North American Aviation's public address system, are being adjusted by sound engineers W. R. Braden and L. Romero. Other banks of units are in the same room.



GROUPED SPEAKERS, powered to overcome maximum noise levels and mounted on 100-foot centers, provide equal distribution of sound clearly audible over the production din.

CHECKING-UP FREQUENCY variations in a six-tone oscillator with a cathode ray oscilloscope is sound engineer W. R. Braden who pioneered the planning of North American's Texas plant P.A. system. His assistant, L. Romero, is servicing an amplifier.

SOCKET - TYPE RELAYS simplify maintenance of the public address system. Here, P.A. Supervisor W. R. Braden replaces a DC 24-volt relay after routine inspection.



FINGER-TIP CONTROL at this compact panel enables operator Aline Hopwood to broadcast to any given section of North American Aviation's Dallas plants. The 128 double-throw switches bring in specific groups of speakers embodied in the mammoth public address system.

Profiting from this previous experience, the engineers reversed their thinking when planning for the second Dallas plant system (in Plant B). Not knowing what the noise level of a given area was likely to be, but realizing that it would never exceed 50 decibels (db), the speakers and power amplification system were planned arbitrarily to overcome the maximum noise.

The systems now installed embody some 942 horns and speakers and 116 amplifiers requiring 35,000 watts input under full operation with an audio output of 8,120 watts—the difference in wattage being dissipated as heat. Power losses have been controlled somewhat by air-conditioning the control room and connecting each rack of amplifiers to an exhaust duct whose fans carries away about 90 percent of the heat.

In the bomber plant groups of four speakers to a bank and two groups to a circuit, with one amplifier per circuit, was found to be a simple and expedient way of solving the impedance matching problems; and of feeding a safe load to each circuit. This arrangement also provided an ideal means of securing equal distribution of sound throughout each area. The groups, being located 100 feet on centers, formed a nearly consummate pattern of sound.

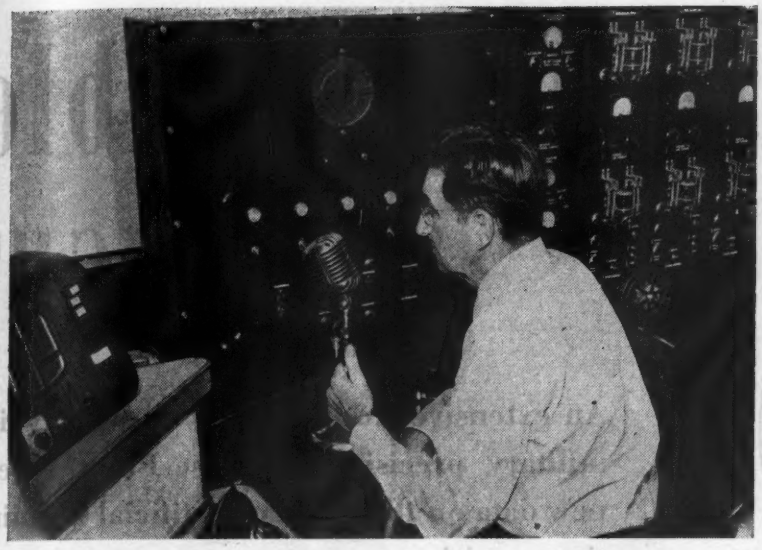
No effort was made to aim the groups of speakers to overcome specific noise levels. Each groups' volume levels can be raised or lowered, either at the amplifiers or at the groups themselves, to overcome existing area noise levels. A standard "L" pad constitutes the group volume control.

Pursuing the unaimed, group-speaker plan, 480 re-entrant expotential type horns were installed throughout the plant and in outlying buildings. And 267 six and eight inch permanent magnet type speakers were set up in the plant's offices. Result was that even in the noisiest departments of the bomber plant, where noise level meters registered 48 db., announcements were clearly audible.

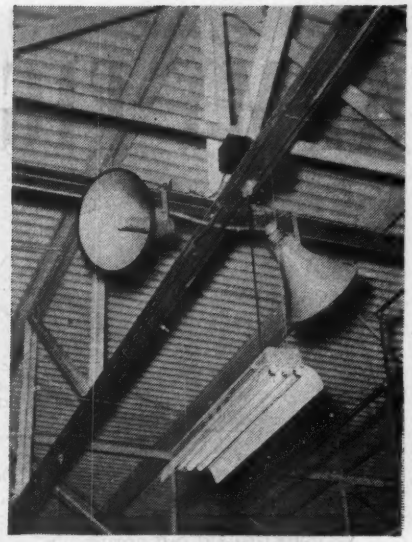
North American's electrical engineers took a standard E75 amplifier and, with a few modifications, adapted it to the needs of the plants. The E75 is a dual channel amplifier with 35 watts output per channel, an overall microphone gain of 124 db., and a phonograph gain of 94 db. Advantage of the dual channel feature, outputs of which are paralleled, is that it still provides a 35 watt output to the speakers even though a tube may fail in one channel.

To simplify maintenance and cut man hours to a minimum, all but two of the 116 amplifiers of the system are housed in a single room. Only five men on three shifts are required to maintain and repair the equipment, including the system's 200,000 feet of wiring.

Relay switching of the B-plus power supply allows tube filaments to be turned on constantly, thereby making them ready for use at all times. By switching the B-plus on and off instead of the entire amplifier, the life of tubes has been greatly lengthened. The d-c 24-volt relays are mounted on a panel, in regular vacuum tube, octal sockets to facilitate maintenance. In the event of trouble this obviates the



***PLANT POLICE TAKE OVER** the plant-wide public address system. Here dispatcher Robert Boylin of the Plant Protection Department broadcasts a code message to the plant protection personnel. This can be done at any time.*



***PRE-AIMED SPEAKERS** designed to cover and overcome noise levels of a given area were installed in the original P.A. system in Plant A.*

necessity of removing wiring. Only the troublesome relay is removed and replaced.

The control bench is a compact unit. On the side panels are 128 Federal anti-capacity, four-pole, double-throw switches which permit the operator to broadcast announcements, news or music, to any given area in either or both plants. Each switch controls an amplifier which powers a group or circuit of speakers or horns. In the "center" or "neutral" position, the power is off; in the "up" position the switch locks and operates a B-plus relay which turns on an amplifier and indicates volume by means of a blinking neon light; in the "lower" or "monitor" position the switch must be held or it will spring back to neutral. In the latter position, the output of the amplifier is thrown across a monitor speaker and volume unit meter, which shows the operator the exact amount of power output of the amplifiers and horns. Additional control switches and pilot lights are provided for the offices and shops in both plants and there is a master switch for all circuits.

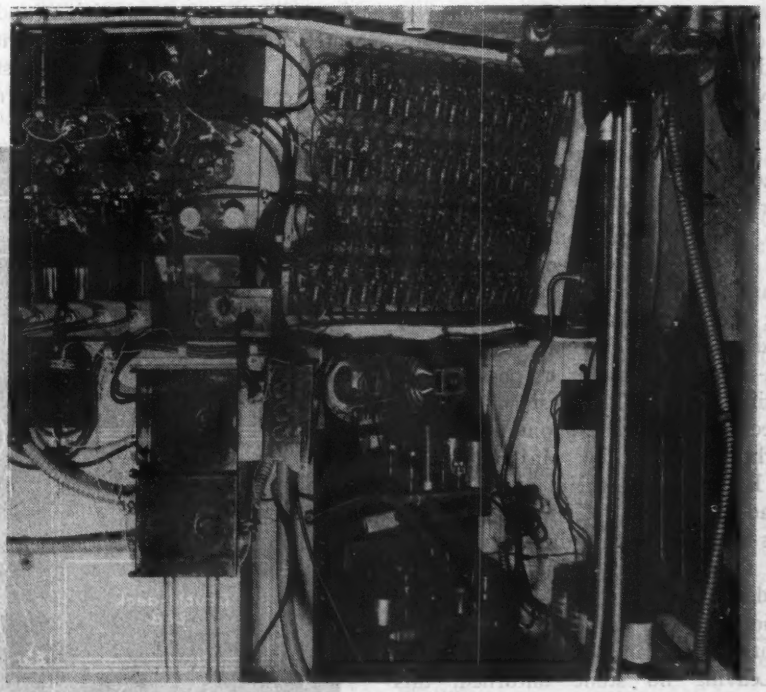
The center operating panel combines mixers of four channels. Each channel, through a switching arrangement, can be used with a high or low impedence source and each has its separate gain control as well as an overall master gain control. Tone control is achieved by means of a broadcast station equilizer which permits the operator to attenuate high or low frequencies.

Three important meters are mounted in the center operating panel. An input vacuum tube meter, which reads as low as 100 microvolts, measures the microvolt input level to the mixer, across microphone and phonograph input channels, situated in the broadcast studio on the floor above. A mixer level meter reads the output of mixer to amplifier racks in db. A db. (decibel) meter, calibrated at a 35 watt zero level across a 500 ohm line, reads the output of any one particular amplifier under the monitor.

Twenty-nine cardioid unidine dynamic microphones are used throughout the plants. Two of these are in the broadcasting room which is also equipped with two turntables operating at 78 or 33 R.P.M. and a broadcast fader control. Two pre-amplifiers in the studio built for flat response from 30 to 14,000 cycles, were created by plant electricians. Remote microphones and turntables are connected to the mixer by plug-in-jack method.

The plants' police department can—and frequently does—take over the system by remote control at any time to broadcast instructions and announcements in code to plant guards and firemen, and to test air raid, evacuation and all-clear signals. At such

[Continued on page 168]



***REAR VIEW OF CONTROL** panel shows the maze of wiring, meter and switch connections. Note radio receiver (under switch panel) used to rebroadcast important news flashes and announcements.*

ARMY FIGHTS Eye Trouble WITH LIGHT

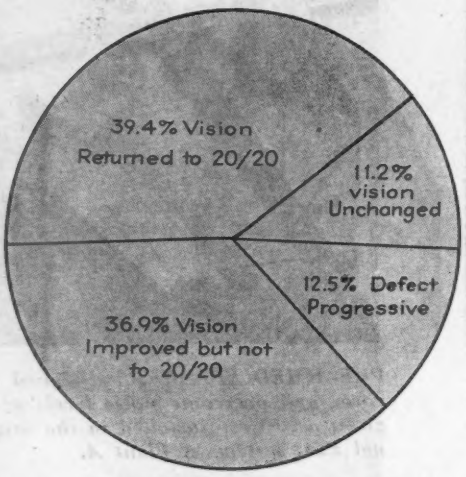


FIG. 1.—Graphical representation of Table V showing state of vision of 160 officers one year after graduating with eye defect.

An extensive study carried on with typical military precision at West Point reveals new data on the effect of artificial illumination on vision.

By Robert E. Miller

IT TAKES four long years of intensive and grueling academic study to turn a West Point Cadet into a full commissioned officer of the United States Army. Investment in this man is high; but his worth to his country transcends the cost. The Cadet's personal contribution is high also in time and effort, in sacrifices, and in measuring up to a stringent set of minimum regulation requirements. Having met and successfully cleared all other obstacles up to the day of graduation, all might be lost should his vision be less than minimum standards set by Regulations. His eyesight was perfect previous to entrance to the Academy. For an eye defect to now deprive the country of his service and him of his commission for which he has striven so hard, would border on catastrophe. And it has happened. But the Army has now taken great strides ahead to eliminate all external mal-influences, insofar as possible, affecting vision. The first step in this direction was the appointment of a Lighting Board by Major General F. B. Wilby, Superintendent of the Academy. His role in the project was that of initiating the study, weighing the recommendations against the evidence compiled and taking final action in favor of the engineered relighting program.

Leaving no stone unturned, this Lighting Board, consisting of three line officers and one medical officer of the United States Military Academy at West Point, has furnished the entire lighting industry with perhaps the most conclusive, concrete and important data available on light versus eyesight. The data is contained in a report compiled from months of research study in a successful effort to obtain appropriations for engineered relighting at West Point. Far-sighted military authorities were unanimous in a decision to determine the effect of artificial illumination on vision, and to protect the cadet officers' eyesight at all costs by taking the proper steps to correct any lighting condition considered deficient or inadequate. The project from the very beginning was planned and executed with all the precision of a military operation.

Several years ago the Lighting Board was called upon specifically to: (1) conduct a survey of lighting facilities in the Cadet barracks to determine whether or not such facilities were proper and adequate for study purposes; (2) submit report on conditions "as found" with references to its adequacy or inadequacy; and (3) submit recommendations for correction of any deficiencies.

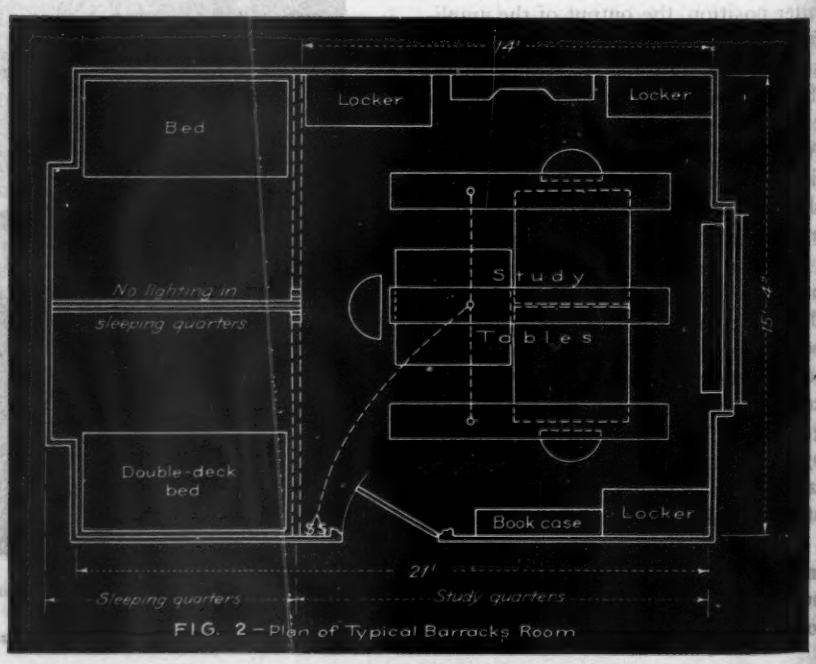


FIG. 2—Plan of Typical Barracks Room

***LIGHTING BOARD** appointed by Major General F. B. Wilby, Superintendent of the United States Military Academy at West Point to study lighting conditions. L. to R.—Colonel C. L. Fenton, Major F. K. Reid, Major G. S. Marvel and Lt. Colonel M. K. Henderson*

Thus was launched the most intensive lighting study on record. The project commanded a most serious attitude and respect, for the eyesight of future officers of the United States Army was at stake; and the Cadet barracks room was the one place where the future officer spent most of his time, studying intensively under the grueling academic program of West Point.

The "meat" of the entire report was found in the records of the Board proceedings. A most startling revelation of the record showed as high as 21.7 percent of the Cadets failed to meet the visual requirements on graduation day (Fourth Class of 1938). This condition existed despite the rigid visual entrance requirements.

Visual data was collected and compiled on eight consecutive Fourth Classes from the graduating class of 1936 to that graduating in 1943. Classes 1936 through 1938 were admitted with a minimum visual acuity of 20/40 in each eye correctible (with glasses) to 20/20. Classes 1939 through 1943 were required to have 20/20 vision uncorrected to obtain admission.

Table I shows that in spite of the more rigid entrance requirement of 20/20 uncorrected vision, no great difference is noted in the percentage of visual defect or deterioration under both sets of admission regulations.

Table II and Table III show that the decline in visual efficiency in many cases approach serious proportions. In all of the groups studied, an average of 57 percent of these graduates who suffered any visual deterioration or loss whatsoever fell into the category which is rated by the American Medical Association as a decline of 36 percent (20/70 or worse) in visual efficiency; 29 percent fell below the 50 percent A.M.A. rating (worse than 20/100). When compared to the New York State Compensation Commission ratings, the declines take on even more serious significance. The N.Y.S.C.C. ratings are admitted to be stringent ones but nevertheless designed as an accurate estimate of the true amount of handicap suffered by the man whose eyes are essential to his gainful employment.

Further Evidence

Table IV provides further evidence that prolonged and continued use of the eyes for study and all manner of near work under inadequate light has a bad effect on eyesight. The evidence was found when the Classes of January 1943 and June 1943 were examined to determine their physical qualifications for cadets for flight training. Twenty-one percent of the first class and 22 percent of the second class lacked the 20/20 vision necessary to qualify. It is to be remembered that the data in Table IV concerns Cadets whose eyesight upon admission were under the new regulation of 20/20 entrance vision.

The evidence of greatest moment, however, is provided by Table V and shown graphically in Fig. 1 for a group of 160 officers of the classes of 1936 and 1937. Here is conclusive evidence that some condition exists which aggravates eye troubles. However, given a chance to rest and recuperate, 76.3 percent of the affected eyes either returned to 20/20 vision or showed improvement. The vision of 11.2 percent remained unchanged from what it was upon graduation and only 12.5 percent of the officers with defective vision were becoming progressively worse. It is to be borne in mind that all of the officers concerned in this study had suffered varying degrees of loss in visual efficiency aggravated constantly during their stay at the Academy. Also, the period of one year which elapsed between graduation and the final eye examination was spent on full field duty where the eyes were used for long-range seeing and very little close work, permitting ample time for the eyes to rest and recuperate from the rigorous four years of academic preparation.

In concluding the report, the Lighting Board felt that this *"universally*

TABLE I

PROGRESS OF VISUAL DEFECTS UNDER OLD AND NEW REGULATIONS

Visual Standard:	20/40 vision, correctible to 20/20				20/20 vision without correction					
				Three Year						Five Year
Class:	1936	1937	1938	Total	1939	1940	1941	1942	1943	Total
20/20 Vision Entrance—%:	89.4	91.5	87.0	89.3	100	100	100	100	100	100
20/20 Vision Graduation—%:	70.8	74.1	72.3	72.4	77.1	74.6	77.6	80.6	79.2	77.8
% at Graduation Falling Below Standard For Commission:	16.8	15.7	21.7	18.1	19.2	17.2	12.4	12.1	11.0	14.4

present factor affecting a decline in visual efficiency regardless of admission regulations" was the condition of the lighting facilities in the study and class rooms; and that the quality and quantity of light afforded Cadets for study purposes had a direct bearing on the visual efficiency of the Corps as a whole. The inadequate illumination was found to be definitely aggravating and was deteriorating those eyes which had any tendency whatsoever toward weakness, even subjecting to considerable strain those which were nonetheless able to carry the burden.

To strengthen their conclusions, it was pointed out that about 75 percent of the Cadet defective visions were the commonest ocular refractive defect requiring correction by glasses, namely myopia (near-sightedness) and its allied condition myopic astigmatism. It is definitely conceded by leading specialists and other medical authorities that such conditions are aggravated by an attempt to use the eyes under unfavorable and inadequate light.

Thus the recommendation was made that the minimum level of diffuse illumination throughout the Cadet barracks rooms be between 35 and 50 foot-candles as agreed by professional opinion on the part of both medical men and illuminating engineers for this type of intensive study work. "It is of prime and paramount importance that adequate lighting, both in quality and quantity, be provided for this intensive study work required by our academic program."

Conditions as Found

Although foot-candle levels of 30 and 35 foot-candles were found to exist in the study rooms, the area of such levels were too confined to provide comfortable study conditions. The Cadet rooms are all identical in layout, and all were formerly lighted by a single hung incandescent fixture with opal diffusing globe containing a 100-watt lamp. In addition, the three student desks were provided with local light from two I.E.S. lamps of 150 and 100 watts respectively. Light-measuring instruments showed sufficient levels within a small radius of the lamp base only. When a Cadet used the total surface of his desk for placing reference material, etc., his eyes would be put to considerable strain wandering from point to point where levels of light ranged from only a few foot-candles to 30 and 35 foot-candles. Nor could adequate levels be obtained should the Cadet desire to tilt his book and lean back relaxed in his chair. Only a fraction of a foot-candle could be obtained by the student who preferred the extreme position of relaxing back with his feet on the desk for comfortable reading.

Furthermore, the efficiency of the lighting system was decreased by the dark color of the furniture, lockers, floors, and desk tops.

An extensive study followed into the most modern techniques and practices used in the science of illumination. A National Better Light—Better Sight Bureau committee was called in to make a study and recommendations. The best illumination experts in the country, including Dr. Matthew Luckiesh were called in for opinions and recommendations. The coordination of the project, the preparation of the specifications and the drawing up of final plans were done under the direction of Colonel Edgar W. Garbisch, District Engineer, New York District Office, U. S. Army Engineers.

The firm of York and Sawyer, architects, was retained to make additional professional contributions to the final analysis and recommendations. Plans and specifications were then prepared by them under the direction of Lt. Colonel Charles K. Pannish, Chief, Engineering Division, New York District Office.

The final recommendations of the report were to provide a general, diffuse illumination of 35 to 50 foot-candles and to completely redecorate the barrack room interiors. The redecoration consisted of painting ceilings and top walls (12 inches below ceiling line) an eggshell white of better than 75 percent reflection factor; sidewalls to be painted soft pastel with reflection factor not less than 50 percent; floor, beds, lockers, desks and chairs be painted a cool neutral color for proper contrast; and desks to be covered with a light linoleum.

Quality of Light

Although the range of quantity had been decided by the original report, the quality was yet to be determined. The architect, the District Engineer and the Lighting Board concurred in a recommendation to seek from the various lighting manufacturers information, advice, opinions and recommendations. Seven leading companies expressed a desire to cooperate by installing in separate sample rooms a design by their own engineers using their own fixtures to meet the specifications already set up.

TABLE II

DISTRIBUTION OF VISUAL DEFECTS AT TIME OF GRADUATION

Class	Total No. Defects	Degree of Visual Defect in One or Both Eyes						
		20/30	20/40	20/50	20/60	20/70	20/80	20/100 or over
1936	80	12	22	5	0	17	0	24
1937	76	11	19	4	2	13	3	24
1938	83	8	10	11	11	8	9	26
3 yr. total	239	31	51	20	13	38	12	74
Percent	100%	13.0%	21.3%	8.4%	5.4%	15.9%	5.0%	31.0%
1939	103	5	12	13	12	17	4	40
1940	113	13	24	16	10	15	12	23
1941	94	20	22	6	8	16	1	21
1942	73	15	12	15	0	21	0	10
1943	85	24	18	16	0	18	0	9
5 yr. total	468	77	78	66	30	87	17	105
Percent	100%	16.4%	16.6%	14.1%	6.4%	18.6%	3.6%	22.4%

Two of the manufacturers set up both a fluorescent and an incandescent room. Out of the total of nine sample rooms, two were lighted by incandescent and seven by fluorescent.

After much study and measurement, the best fluorescent design and the best incandescent design were selected for further study. Both were of a direct-indirect type. The measurements which were taken included horizontal, vertical, and 45 degree foot-candle levels at various points on the desks and throughout the room, plus brightness values of the fixtures, sidewalls and ceilings as seen by the eye from a sitting position at the study table. The incandescent design consisted of two 500-watt fixtures, while the fluorescent design called for a total demand of 600 watts (including losses) for the 12-40 watt lamp installation illustrated in Fig. 2.

Typical average maintained foot-candle levels for the fluorescent room were for vertical, 45 degree and horizontal—36, 20 and 24 foot-candles. The average brightnesses measured in foot-lamberts were—100 F.L. for the darkest spots on the ceiling between units and about 200 F.L. for the brightest spots.

In comparison, typical incandescent measurements, computed with similar depreciation and maintenance factors revealed readings of about 33, 21 and

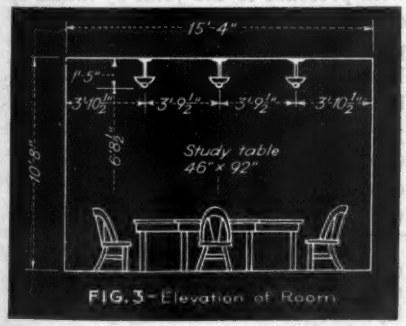


FIG. 3 - Elevation of Room

12 foot-candles for desk surface, 45 degrees and horizontal values respectively. Brightness readings varied considerably but typical values were 30 and 3000 foot-lamberts for dark and bright spots respectively.

Comparative Costs

Included in the study was a complete break-down of installation, operation and maintenance costs of the fluorescent versus the incandescent design, plus decoration costs which were the same in both cases.

The installation costs covered completely installed estimates which included the additional and replacement wiring caused by the change from 1 phase 3 wire to 3 phase 4 wire and

STUDY QUARTERS of a barracks room. Cadets now work under high quality illumination with sufficient light for any assumed study position.

that necessary to provide the additional copper capacity. Energy consumption required by the higher incandescent demand per room figured about 42 percent more than the fluorescent.

Maintenance costs included ballast, starter and lamp replacements, and the labor cost for these replacements plus cleaning. To the maintenance total was added the cost of current to give an overall grand total of operation and maintenance cost for comparison.

Final Selection

With these figures in mind, the Board set out to make final recommendation for a selection. On the basis of a quantitative analysis, both incandescent and fluorescent designs were considered adequate and comparable. With regard to a qualitative analysis, the fluorescent design was given a considerable edge. The incandescent installation was found to be harsher, exhibiting much higher brightness ratios. Capacitor-reactor circuits for adjacent tubes eliminated stroboscopic effect and the fluorescent fixtures, which are 85 percent indirect —15 percent direct, gave a softer, more diffused quality of illumination. In addition, the fluorescent was found to more nearly approximate daylight, blending therewith when the two were supplemental. In the opinion of the Board, "there is no question but that the quality of light secured from the fluorescent system is infinitely the better of the two (with) visual efficiency directly proportionate to quality."

These analyses and recommendations were turned over to and weighed carefully by the military officials concerned, and the fluorescent design was finally decided upon as most favorable to the paramount consideration—greater visual efficiency.

Accepting the foregoing premises, this was a logical solution even if costs had been given no consideration whatsoever. For no value can be placed on eyesight; and if it could be evaluated, the figure would far outweigh any material costs, especially when considered in the light that the Cadet's eyes were perfect (according to accepted standards) upon admission to the academic phase of a long career dependent upon continued, perfect or near perfect vision. Future tests of cadet eyesight under modern illumination should reveal more significant data.

Actual Installation

The District Engineer's Office which had been working closely with the Board all along, then prepared the specifications and let the contracts. The installation of this work was executed under the direction of Lt. Colonel David F. Fisher, Chief, Operations Division, and Major Robert L. Donnely, Area Engineer, Northern Construction Branch, both of New York District Office. The successful bidder on the fixtures was Edwin F. Guth Company with their special "Cadet" unit redesigned to meet the specifications on radio interference, stroboscopic effect and general noise

[Continued on page 166]

Phos-Copper Brazing OF ARMATURE COILS

Phos-copper brazing has been developed for making coil-commutator joints stronger and more reliable.

SOLDER has been universally used for making the connections between armature coils and commutator necks, and between armature cross connections and armature coils on direct current motors and generators since the development of d-c machines. Solder has been used because soldered joints are easily made and provide good contact when correctly made. Until very recently, no other commercially satisfactory means had been developed for making these joints. Soldered joints have three fundamental imperfections: (a) the joint is relatively weak mechanically, the strength decreasing very rapidly with increasing temperature due to the nature of the material, (b) the joints will not stand very high temperature since ordinary solder (50–50 solder) melts at approximately 183° C. and, (c) there is no known way of telling whether a good or poor soldered joint has been made.

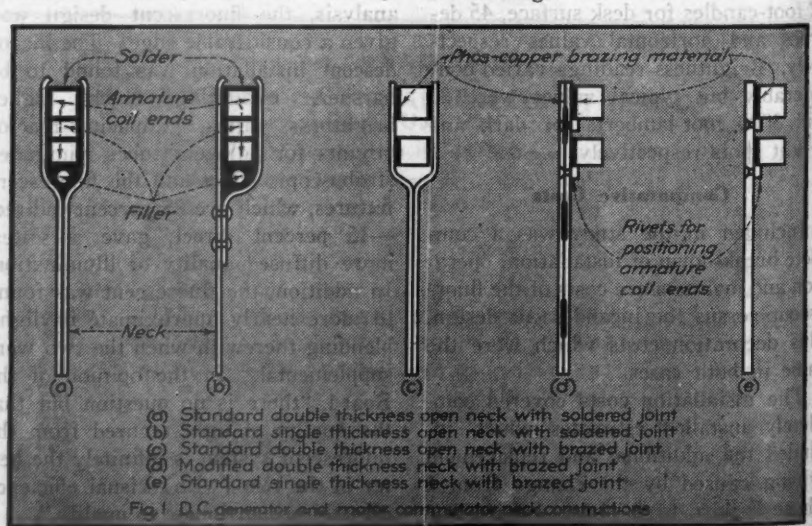
On some machines and on practically all machines with Class "B" insulation, which includes all railway equipment, these joints have been made with pure tin instead of solder on account of the higher temperatures at which these machines operate. Since tin melts at 232° C., higher operating temperatures can be employed when it is used.

After our country's entry into the war, a drive was made to conserve tin on account of its scarcity and Westinghouse started developing a brazed type of joint for these connections. Similar efforts made in years past were never successful in developing a method that was commercially practical for large scale production. Brazing with a flame is impractical on account of the spread of heat and accompanying damage to adjacent parts, particularly to the insulation. This has, however, now been accomplished for commutators with open type necks.

Fig. 1 shows the various types of commutator necks employed on d-c mechines of our manufacture. Construction (a) and (b) show standard types used on soldered joints; (a) is most commonly used. Note, that in the case of (a) the neck is made of a double thickness of copper with the outer periphery opened to form a space for the insertion of the armature coil ends. This neck may be of two pieces, riveted or spot welded together, or may be of one piece folded to give two thicknesses. The second type shown in Fig. 1(b) is also used when the commutator bar pitch is very thin, in which case only a single thickness of neck material is used, with an additional piece riveted on, to form an opening, at the outer periphery for the armature coil ends. The soldering of these types of necks is similar, and it is necessary to use filler pieces of copper of the same thickness as the armature coil ends, between the top and bottom armature conductors and in the opening below the bottom armature coil end.

Construction (c) shows a type of brazed joint in which the armature coil ends are simply brazed to the standard type of neck, as used with the soldered joint. However, the copper filler pieces have been omitted below the bottom conductor coil end and between the top and bottom coil end. In brazing this type of joint, thin strips of phos-copper* approx. 0.015 inch thick (with a width equal to approximately half the width of the neck), are inserted between each side of the armature coil ends and the neck. Heat, from a brazing transformer, is then applied with pressure to the joint by means of carbon tipped brazing tongs. After the phos-copper has melted (815°C.) and has flowed over the surface to be brazed, the current is stopped but the pressure is maintained till the joint cools. In normal production, a blast of compressed air is applied directly to the joint whenever current is not flow-

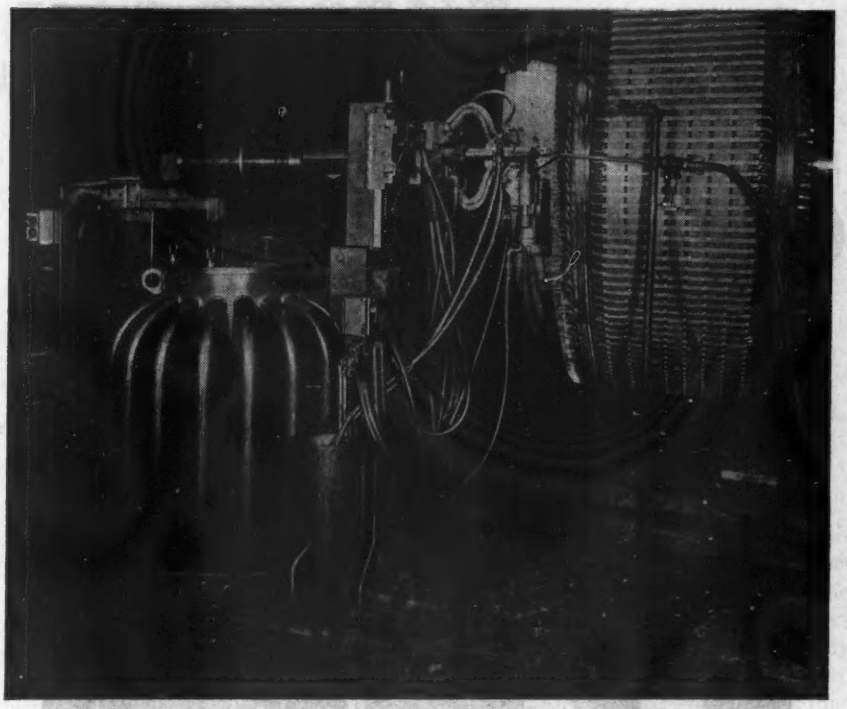
* Phos-copper is an alloy of phosphorous and copper and is used as a brazing material for copper and copper base alloys. It has a low melting point and is free-flowing.



(a) Standard double thickness open neck with soldered joint
(b) Standard single thickness open neck with soldered joint
(c) Standard double thickness open neck with brazed joint
(d) Modified double thickness neck with brazed joint
(e) Standard single thickness neck with brazed joint

Fig. 1 D.C. generator and motor commutator neck constructions

By C. Lynn
Manager,
D-C Generator Engineering Dept.
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.



BRAZING ARMATURE COILS to commutator necks using phos-copper and tong method.

ing. Thus, when the circuit is interrupted at the end of the melting period, this air tends to rapidly cool the brazed joint. An improvement that has been developed consists of blowing a small stream of air in a radially-inward direction against and between the armature conductors just back of the commutator necks. This keeps the conductor cool, and eliminates damage to insulation. In making a joint in this manner, it is possible to braze armature coils with Class "A" insulation without damage to the insulation. Since the armature conductors are brazed solidly to the commutator necks, no spacers are necessary between conductors or below the bottom, since it is not necessary to fill this space with brazing material. It should be pointed out that the resistance of a brazed joint is somewhat higher than that of a "good" soldered joint due to the inherent higher resistance of the material itself. However, since the resistance of either joint is a few microohms only, the value is of no practical consequence.

Construction (d) figure 1, shows another type of brazed joint similar to the type shown in (e). In (d) two pieces of copper are brazed together to form the neck. This method is used where the neck material has already been made, or where the necks have been partially formed in the shape shown in (a), and have then been reformed to that of (d).

In (e), the neck itself is made of one piece of copper, with thickness equal to the total thickness of the soldered type neck shown in (a) or (b). This thickness, of course, varies with the design and current rating of the machine. In this construction small copper rivets are inserted in the neck (in the correct position before the necks are attached to the commutator bars) to properly locate in a radial position the ends of the armature coils for brazing. It is also possible to omit these small rivets and simply locate the position of the armature coil ends, radially, by reference to the outer periphery of the armature iron, through use of a straight edge. Small pieces of phos-copper (approx. 0.015-in. thick and about half the area of the overlapping of an armature coil end on the neck) are spot welded to the neck to prelocate the brazing material. This provides the exact amount of brazing material necessary for brazing the joint. Too little or too much phos-copper brazing material results in an inferior joint. After the necks are prepared in this manner, they are brazed into a slot machined in the bar. Before brazing was used for attaching the necks, in the bars, the necks were held in position by soldering and riveting with countersunk rivets. For the past two and a half years Westinghouse has eliminated this riveting and soldering and has simply brazed the necks directly into the slots.

Tong brazing with phos-copper is well suited to making multiple-joints as encountered on commutator necks and armature coil-ends, because it does not require a bright surface for the work. Flux, which may cause damage to adjacent insulation, causes corrosion of the metal and peeling of varnish and paint is not needed. Even copper which has been tinned or soldered can be brazed, if phos-copper brazing material is used. At room temperatures, the phos-copper joint is approximately four times as strong as a perfectly-formed soldered joint, using pure tin. With an increase in temperature, the phos-copper joint becomes many times stronger than a tinned or soldered joint. Then, too, the brazed joint can be taken apart when desired—by applying heat through use of the tong, and simply separating the pieces while hot.

In making armature coils for soldered joints, ends of the coils are pre-tinned after the coils are formed and before they are treated in varnish. After the coils have been treated in varnish, the varnish is removed from the ends by dipping into a pot of melted tin or solder. When soldering with pure tin, the pre-tinning must be done with pure tin also, so as not to contaminate the final pure tin joint with lead. It is absolutely necessary to pre-tin the ends of armature coils before making a soldered joint. It is also necessary to pre-tin the open ends of the commutator necks before soldering the armature coils to the necks.

When brazing is used, no tinning of any kind is necessary on the open end of the commutator necks. The armature coils, however, are pre-tinned and re-tinned in exactly the same manner when the coils are to be brazed as when they are to be soldered, except that pure tin need not be used. Attempts to eliminate pre-tinning and re-tinning of the coil ends .(by various other methods for removing varnish from the coil ends such as sand blasting, acid treatment, etc.) have uncovered no method that compares, in ease and cheapness, to that of removing the

***PORTABLE TONG BRAZING OUTFIT** being used to join armature coils to necks.*

varnish by tinning. Phos-copper brazing material is ideal since it will braze even with the coils tinned or covered with a thin amount of solder. Not only does it permit following through on the manufacturing program but also permits brazing armature coil ends and commutator-neck joints, which have previously been soldered. In such cases, it is only necessary to split the joints, heat the materials, remove (with a rag or other means) the bulk of the solder from the copper, place pieces of thin phos-copper strips in the joint in the manner mentioned under the brazing of the type shown in (a) and braze.

Experiments and development work are being continued on brazing technique in order to improve brazed joints and cut down the time required to make them. At present, it takes somewhat longer to make brazed joints than soldered joints. Eventually, it is hoped that it will be possible to make brazed joints as quickly.

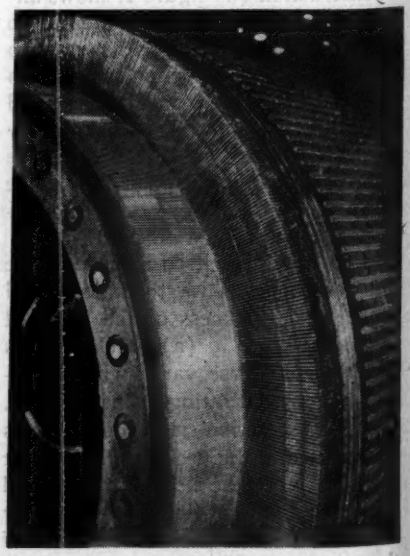
Brazing Stands

Brazing stands are used for work on the commutator necks in the Westinghouse shops. These stands consist of roller bearing supports, adjustable in height and spacing, to support the rotor by means of the shaft. This permits the armature to be placed in correct relationship to the brazing head and permits easy turning of the rotor, bringing different joints successively to the head. The brazing head itself consists of air operated "tongs" having parallel moving jaws. They can move inward or outward, in a radial direction along the commutator neck, for brazing the outer or inner armature coil ends. They can also move in an axial direction to permit insertion of the carbon jaw tips used for gripping the joints to be brazed. The carbon tips are thin and tapered and each is connected to the brazing transformer through suitable flexible leads. These tips can be shaped to any size required, depending upon space available between necks and size of necks and coil ends. It is necessary to bend adjacent necks slightly away from the neck being brazed. Some difficulty in bending may be encountered on extremely short necks. The neck being brazed lies in a horizontal position. By means of a lever, the carbons are positioned above and below the joint. A lever is pressed with the foot which admits air to a hydraulic cylinder and presses the carbons together. Current is applied by further travel of the foot lever. A continuous small stream of compressed air, blowing from a fixed orifice adjusted to the correct location for the particular armature, blows against the armature coil just back of the neck, keeping it cool and eliminating damage to insulation. When the prelocated phos-copper, previously spot welded to the neck, melts and flows out over the joint to be brazed, the operator releases the switch, stopping the current flow. However, he still maintains pressure on the joint. When the circuit is interrupted, an additional air blast blows through a hose and small orifice near the tip of the jaws, cooling the joint quite rapidly. In a very few seconds the phos-copper will have hardened and the jaws can be released.

To break one of these joints the process is reversed. The joint is heated with the tong and as soon as the brazing material starts to flow, the current and pressure are released and the two pieces are knocked apart. It is possible to make and remake a joint three or four times without adding brazing material. Brazed joints made as replacements for soldered joints, using the type of construction shown in Fig. 1 (c), are somewhat more difficult to open. Those made as shown in (d) and (e) are very easily opened. Below is shown a commutator end of a rather large armature whose armature coils and commutator necks have been phos-copper brazed, using the latest type of neck as shown in Fig. 1 (e).

For use in the field or in manufacturing and repair shops such elaborate equipment is, of course, not needed nor justified. A portable type of brazing transformer equipment, with ad-

[Continued on page 167]



***COMPLETED ARMATURE** — after coil-neck joints have been brazed with phos-copper.*

FLUORESCENT MAINTENANCE CONTRACTS

New business is available now and postwar in planned fluorescent lighting maintenance programs.

By Don G. Mitchell
Vice President,
Sylvania Electric Products, Inc.

FEW INDUSTRIES have enjoyed the rapid growth and widespread acceptance equal to the record of fluorescent lighting. Contractors have seen this development through two important stages: (1) manufacturing and (2) sales and installation. The success of this second phase may be attributed in a very large measure to the efforts of electrical contractors, with the result that they have not only created a very promising future for the fluorescent lighting business, but they have also created a market for flourescent lighting maintenance.

Proof that regular fluorescent lighting maintenance is a genuine need is borne out by the fact that many large war plants have established their own regular maintenance service for their lighting installations. *The primary object of this service is to maintain levels of useful illumination which were originally engineered and installed as a means of more efficient production.* Unfortunately, a similar type of maintenance service has not been available in smaller industrial plants and the majority of commercial installations during the war, though in most instances the maintenance of good lighting is not less important. The reason seems to be that lighting maintenance in small industrial applications and in practically all commercial applications requires the specialized periodic service most satisfactorily rendered by an outside organization. It is just the sort of service that can be very profitable to electrical contractors who work out a plan to fill the need.

A pretty good common denominator of the need is revealed by a recent survey which shows that fluorescent lamp outages in commercial fixtures average as high as ten percent. This condition exists in spite of the relatively long life of fluorescent lamps in commercial service and shows the size of the job, right now, simply to replace burned out lamps assuming that is all that is needed to return existing fixtures to normal operation . . . giving the user the amount of useful light he needs and wants.

From this survey and since commercial customers use an average of about $81 worth of electricity annually for fluorescent lighting, this means that utilities throughout the country are losing a total connected lighting load worth about $3,400,000 a year, and it is safe to assume that they will look favorably upon any plan that gets these lamps burning again.

The electrical contractor is the logical person to institute a service of this kind. His men know fluorescent lighting equipment. They know how to check and service starters, ballasts and wiring. They know when lamps should be replaced in a wide variety of operating conditions. They know where most of the fluorescent lighting installations in their territories are located. They have served the owners for many years, whenever they have needed new electrical equipment or service. They have been the people consulted most often about electrical equipment and maintenance. For years, the electrical contractor has trained personnel to take care of the selection, the installation and repair of lighting and other electrical equipment of all kinds.

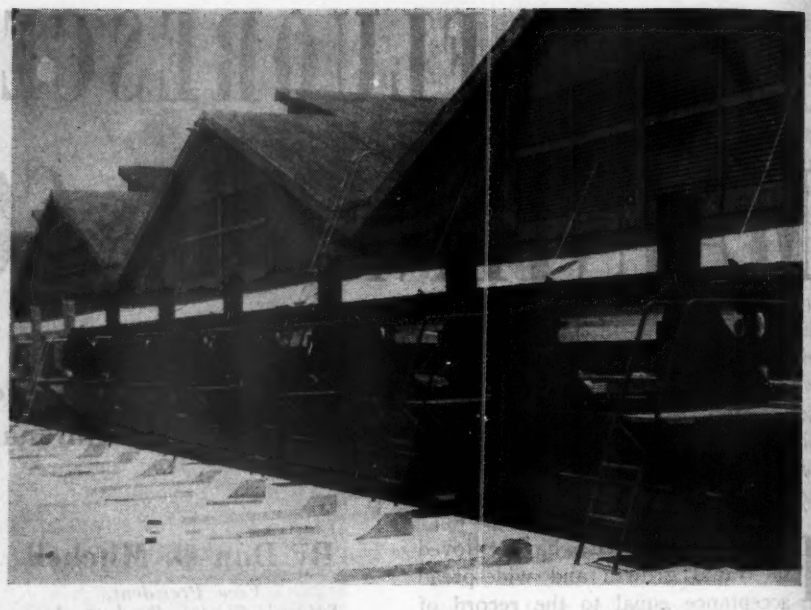
These facts are borne out by the experience of those electrical contractors who are already supplying planned fluorescent lighting maintenance service. They report that they are fully sold on the idea. They also say they see no reason why their maintenance business will not yield increased business and increased profits during postwar. Their customers appreciate the economy resulting from the high average lighting levels made possible by planned maintenance service.

Experience so far clearly shows that the key to the success of a fluorescent maintenance business lies principally in the clear definition of a sound plan at the very beginning. The definition will, of course, depend on several factors which will vary in different parts of the country and must be appraised and applied individually by each individual contractor. In general, however, they include the answers to the following questions:

1. What specific services will be rendered?
2. How much and what kind of additional help and equipment will be needed?
3. How are costs, charges and profits estimated?
4. What form of contract should be offered?
5. How long a period should the contract cover?
6. How, when and where should maintenance service be solicited?
7. What is the best way to avoid unnecessary and expensive call backs?
8. How long do lamps, starters and ballasts last?
9. How successful have other contractors been?
10. What do other contractors charge and what profit do they make?

These are the more important questions asked by electrical contractors. They want to know how these questions have been answered by other contractors, not to evolve an elaborate plan but rather to determine a relatively simple, direct, profitable procedure suitable for their own use.

[Continued on page 168]



LOADING PLATFORM where field trucks unload the bulk fruit directly into the conveyor system. Note that each line is provided with its individual control box.

CUSTOM-BUILT

Control unit designed and fabricated in the plant electrical shop from standard devices to provide remote speed control over 30 - 1 range for fruit conveyors.

By W. W. Ruddock

Chief Electrician
Maui Pineapple Company, Ltd.
Kahului, Maui, Hawaii

FOURTEEN separate conveyor lines, handling bulk fruit, are controlled from a single control desk mounted high in the air overlooking the transport area of the Kahului cannery, Maui Pineapple Company, Ltd., in Hawaii. The drive unit on each line is supplied from a separate motor-generator set to provide for the required conveyor speed to synchronize the fruit feed supply to the cannery production processing.

The new conveyorized system is a great improvement over the old system utilizing lug boxes to transport the fruit. The pineapple is now collected in field trucks with specially designed bodies which, when loaded, are dispatched to the cannery where they are unloaded directly into the conveyor. This bulk handling affords greater plant capacity than the old individual handling of the lug boxes.

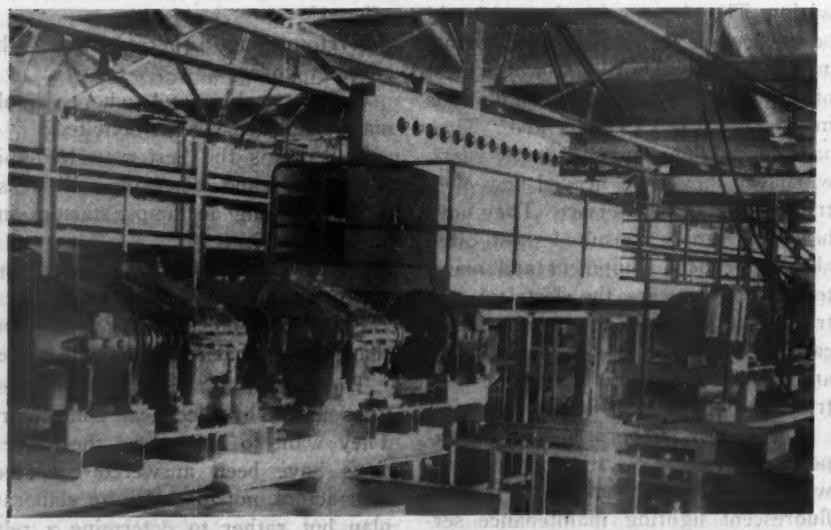
The main control desk, designed and fabricated in the plant electrical shop, has all the controls mounted flush. The pushbuttons are standard purchased items, and are mounted beneath the horizontal table top. Access is from below so that buttons may be easily removed and replaced in case of trouble. Likewise, each rheostat is mounted in a separate panel to facilitate its replacement in the event of a defective unit. The rheostats are installed in the vertical backstop riser of the desk to provide for easy manipulation of the dial.

Each line has two start-stop buttons and one rheostat. One pushbutton station controls the m-g set; the other controls the conveyor driving motor. Each m-g control station has an indicating light to notify the operator whether it is running or stopped.

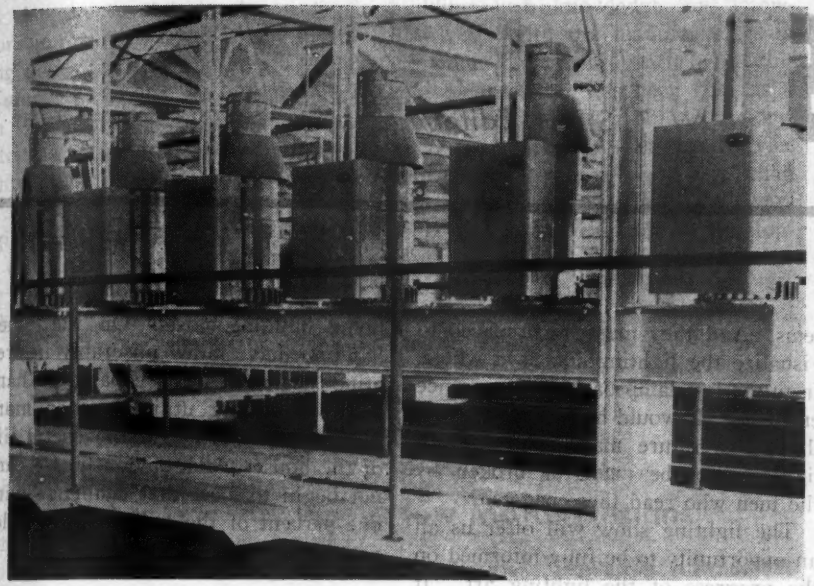
The entire control desk is well lighted by two 40-watt fluorescent lamps installed end-to-end in the canopy over the rheostat panels and controlled from a switch on the desk.

Since flush-mounting rheostats and pushbutton stations were unobtainable, standard surface-mounting units were adapted, making the design and fabrication a little more difficult but much more interesting.

The purpose of the central control desk is to permit one man to control the flow of fruit along the entire length of the 14 conveyors, and to synchronize the quantity of input fruit to the processing system on signal to the operator. Motor-generator units can be started and stopped, as can the individual driving motors. The operator, in addition, has continuous control of the conveyor speed from approximately three inches to 7 feet 8 inches per minute.



MAIN CONTROL DESK is mounted high above the floor at the very center of the transport area, and is flanked on each side by individual main drives which include motor and gear reduction units.



***SIX OF THE SEVEN UNITS** comprising one bank of m-g sets. At upper left, conduit risers enter the bank wireway. Catwalk is suspended at one side to make units easily accessible.*

Industrial Control

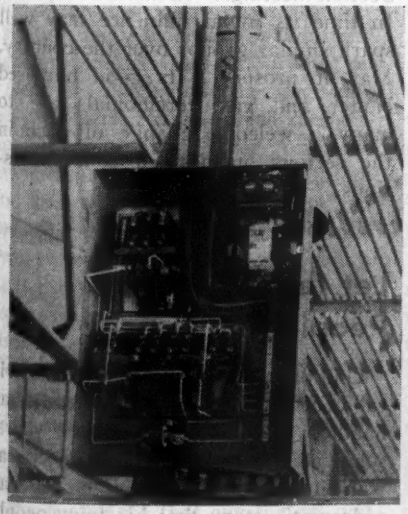
Each motor-generator set may also be start-stop controlled at the unit. As shown by the accompanying illustrations, the m-g sets are vertical units with the control mounted directly to the motor frame. Interlocking relays are incorporated in the control housings so that an additional point of independent control is obtained. This independent control station is outside the building where the bulk fruit is unloaded from the field trucks. Thus, by first stopping the d-c drive motor and then starting it again, interlocking relays operate, transferring control from the main control desk to the loading platform control box. The main control desk operator regains control by similar manipulation of his drive-motor start-stop buttons.

Each loading platform control box also embodies a speed-control rheostat so that after gaining control of a particular conveyor line, the loading-platform operator can alter its speed to suit the requirements of the loading operations.

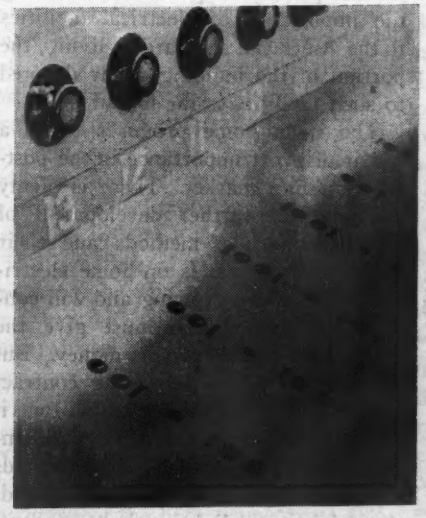
Each main drive consists of a 5 hp. 230-volt d-c 1150 rpm. motor direct-connected to a Link Belt herringbone gear reducer. The speed range of the motor is 47.5 rpm. to 1550 rpm. which gives a conveyor speed of approximately three inches per minute to 7 feet 8 inches per minute.

The fourteen motor-generator units are mounted in two banks of seven each with the control desk and the main conveyor drives centered in between. This gives a symmetrical layout for a neat balanced, conduit and wiring installation presenting a nice over-all appearance.

Wireways which were fabricated in the plant electrical shop were installed above each bank of m-g sets. Control conduits were then used to carry the wires into a common wireway centered between the two banks. A fourth wireway connected this common wiring gutter with the main control desk. Interconnecting control wires to the loading platform control boxes are carried in individual conduits.



***CONTROL PANEL** of the motor-generator sets are mounted directly to the motor frame. Note directly behind unit the bank of conduits which connect the bank wireway with the common gutter.*



***CLOSE-UP CONTROL DESK** showing flush mounting of pushbutton stations for the main drive motors and the m-g sets. Note that rheostats are mounted in separate panels facilitating quick replacement.*

***CONTROL BOX** is provided with drive motor and m-g set pushbuttons and speed rheostat. Interlocking relays permit operator to gain control at this point by merely stopping and starting motor for adjusting speed.*

EDITORIALS

W. T. Stuart, *Editor*

Lighting Show To Set The Pace

In April of next year, Chicago's Palmer House will be host to an exhibition of modern lighting equipment. Make a note of it now and plan to go, it is important. If preliminary plans pan out, it may well mark the turning point toward a spectacular new era of electrical progress.

Restrictions and regulations are gradually being dropped. The cumulative public interest in modern lighting technique is building a huge market; at the same time the technology of illumination is moving rapidly forward. Here is a set of circumstances that we do not dare to underestimate. Competent observers both in and out of the electrical industry have specified lighting as one of the truly great postwar opportunities for commercial enterprise.

The lighting exhibition will hold the interest of all segments of the electrical industry. It will offer a preview of post war opportunity that is bound to inspire broad scale programs and projects among manufacturers, wholesalers and utilities far beyond their direct concern with lamps and fixtures. Any dramatic move in lighting development carries with it tremendous potential markets for manufacturers of everything from generators to friction tape and opens new prospects for kilowatt hour sales.

It will also be a center of interest for architects, builders, enginers and building managers. Light as a functional element of living, of work and leisure, in home, school, office and factory, is already apparent in projected post war building plans.

But the greatest interest of all ought to come from the men responsible for electrical construction, installation and maintenance, the electrical contractor and the electrical men of industry. They are the specialists who must be thoroughly informed. They are the men who must be ready to bring together the best of fixture and lamp designs to build modern lighting systems. And they must be prepared to visualize the lighting job as a whole, from the last lamp back to the service entrance. It would be fair to say that the whole future market for modern lighting can be made or broken by the men who read these pages.

The lighting show will offer us all an opportunity to be fully informed on the progress of the lighting art. It should inspire a courageous approach to postwar installations. It deserves our whole hearted support.

Too Little for Wiring

A study of housing costs made by the National Housing Agency reveals that in a typical $5000 house the cost of electrical materials at the site is slightly less than one percent. The comparison with such items as roofing or paint, which run 1.25 and 1.41 percent respectively, is a pretty fair measure of how little wiring amounts to as a factor of cost in the low price home. It is hardly a record to which we can point with pride. Considering the importance of electrical facilities to the American standard of living, the portion of the building dollar devoted to such facilities is far too small.

The small home promises to be a factor of great importance in the postwar building market. There is plenty of room for further development of wiring materials, methods and their usefulness. Demands on home electrical facilities are growing and will continue to grow. We must give the home owner more for his money. But so long as the house wiring contract is a minor value, so negligable that it might well be lumped with miscellaneous costs, there will be little methods to create new materials and methods for wiring and lighting improvements in the low cost home.

Electrical utilization has expanded enormously. We have been very successful in keeping the electrical contract in line percentage-wise with other home building costs. On the other hand we have failed miserably in creating wiring systems capable of handling expanding utilization for more than a tiny fraction of the useful life of the house. And, obviously, we cannot begin to meet that challenge with one percent of the building dollar devoted to electrical materials.

May the Juggers Prosper

The deliberations of electrical inspectors in chapter and section meetings are serious, involved, technical and generally pretty weighty. Since matters of safety to life and property are at stake they can hardly be otherwise. But Kentucky inspectors through several years have devoted one luncheon of each session to a unique institution known as the Little Brown Jug Club. Grave issues are shelved for the moment, there are traditional ceremonies, good fellowship and tall stories well told.

During the past two years the Club has staged a luncheon at the Western Section meetings. Its fame has spread. In time its jovial influence may well spark similar groups over the country. May it prosper. Its good humored banter and gay ceremonials are to many a welcome change of pace in the serious business of code discussions.

Let the People Know

One of our good friends, an electrical contractor in an Eastern city has handled during the past three years, some of the most elaborate electrical work in his community. Each job was a dramatic story that his townspeople ought to know about. But they didn't. In fact the only time he ever got in the newspapers at all was when one of his trucks sheered off a Main Street lamp post. If he has ever given ten min-

utes thought to the development of favorable publicity and a sound advertising policy, it isn't apparent.

Unfortunately, he is more typical than exceptional. The reluctance of electrical contractors to face their community public relations job is notorious. It is a deficiency that is so intangible that its cost is never noticed nor calculated. Yet no business can long withstand public indifference and the best way to invite that indifference is to ignore normal interest and curiosity in your company and its plans and activities.

Many of your jobs are dramatic, interesting, even spectacular to the man in the street. Those connected with war activity are news and they ought to be told. What about secrecy clauses? Yes, they mean it. But there are facilities in each of the armed services and in civilian bureaus for "clearing" such stories from the standpoint of military security. For example, every article in this magazine regarding a job connected with war activity has been "cleared" officially through such an office.

The contribution that electrical contractors have made to the building and operation of our great arsenal are tremendous. Yet it is practically unknown, outside of our own industrial family. It is a record in which we can take pride and we ought to let the people know.

Markets Depend on Confidence

A study made by a firm of industrial engineers predicts that the production of electronic products in the immediate post war period may exceed one billion dollars or about three times the prewar figure. Among the many products that will help to make up that total are control devices for motors and power transmission, radio frequency, heating apparatus, welding equipment, dust precipitation and industrial inspection devices.

Whether or not such production volume will be reached is going to depend pretty much on how much industry knows about what electronic apparatus can do. It will depend, too, on the confidence that contractors and chief electricians have in their own knowledge and know-how in the application and installation of electronic equipment.

The burden of responsibility for building such knowledge and know-how rests with the manufacturers of electronic apparatus. Much of this equipment so far has been sold as a specialty and service from the factory. Such an expensive sales and service policy cannot hope to reach more than a small fraction of the potential market. Any broad scale market development must enlist the intelligent cooperation of the electrical contractor and the chief electrician. And they are eager for knowledge.

Silicones Allow New Motor Designs

When glass insulation for magnet wire used in motor windings appeared it was hailed as an important advance. Motors could be designed to operate at much higher temperatures. Practically, however, there was a hitch. The Fiberglas wire insulation could stand relatively high temperatures, but the varnishes which sealed out air and moisture could not.

The development of "silicones", a group of plastics which bridges the gap between the organic plastics and the inorganic, now includes a varnish which will take exceptionally high temperatures. These semi-inorganic high polymers are based on silicon and oxygen instead of carbon. The chemical structure is similar to Fiberglas, mica and asbestos, characterised by unusual thermal resistance and chemical stability.

Thus, coils insulated with inorganic materials such as Fiberglas mica or asbestos and treated with silicone varnish introduces a new class of insulation, resistant to heat as well as moisture and able to withstand tough service conditions. And the qualities of resistance to moisture and tough service may be as important in time as resistance to heat.

The handling of silicone varnish is reported to be similar to other types of varnishes with an increase in baking temperatures. As the new material becomes available for rewinds, the motor shops will rapidly work out the necessary know-how.

In time we can expect new motor designs for special applications to take advantage of the high temperature and moisture resistance qualities of the new material. New applications for motors and new sales opportunities will inevitably follow this important development.

Washington Notes

► With elections over, watch for a rush of changes in war regulations. Many perfectly innocuous revisions have been held up to prevent violent partisans from seeking political implications in every paragraph.

► There is real worry in high quarters over the tendency to let down. Very serious shortages are cropping up, small compared with total industrial output, but critical items are involved. Moves toward reconversion, already under way, may have to be stopped or slowed down.

► Sixth War Loan is looked upon as the most important of all now in the grim battle against inflation. Attempts to break the Little Steel formula will be resisted.

► W. P. B. is establishing a Construction Bureau which will include the existing Building Materials Division, the Plumbing and Heating Division and the Facilities Bureau. This is part of the unwinding process. It provides centralized control and at the same time provides a mechanism for active promotion of construction work when diminishing war requirements permit.

► L 225, controlling conduit, has been revoked. There are no more limitations on the use of conduit and no preference ratings are necessary to buy or sell. Rated orders still come first.

► C. M. P. Regulation 6, however, still limits conduit and wire sizes to the minimum required by the National Electrical Code.

► Minor capital improvements up to $500 may now be made by government agencies and institutions under C. M. P. Regulations 5 A. They are now on a par with industries and business houses under C. M. P. Regulation 5.

► Wages earned by veterans who qualify for apprentice training, will be supplemented by monthly allowances provided by the G. I. Bill of Rights, a subsistance allowance of $50 to $75 a month.

► An amendment to L78 now permits the manufacture of individual or continuous row fixtures using five or more rows of tubes. Sale of parts for fluorescent fixtures may now be made only on rated orders.

► The H2 program will open the way to larger and better quality housing in congested areas according to N. H. A. Top sale price of $8,000 and $65 rental are established in selected high cost areas.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

PORTABLE TEST CABINETS SPEED TOOL REPAIRS

INDUSTRIAL

With the number of portable electric tools that come into the repair shops of plane plants each day, a systematic method of testing and checking to diagnose the trouble is a maintenance "must". Realizing this, the Texas Division of North American Aviation, Inc., Dallas, has devised a symmetrical panel which coordinates into a single unit all the test outlets necessary to check their portable tools.

The panel is built of sheet metal and is in a cabinet form measuring 8-in. by 12-in. by 24-in. and encloses the various test receptacles. Salient features of the test panel (see photo) are:

1. Outlet for soldering iron, including pilot light, control switch and "high-low" rheostat for heat control.

2. A 220-volt, 3-phase, 60-cycle outlet for testing single and 3-phase, 220-volt vacuum cleaner motors and other equipment.

3. A double-position switch (light-element) for continuity tests to check open circuits and proper motor connections.

4. A high-frequency outlet (250-cycle, 350-volt, 3-phase) for testing high-cycle equipment.

5. Three, 110-volt, single-phase, 60-cycle, outlets for making running tests on single-phase motors.

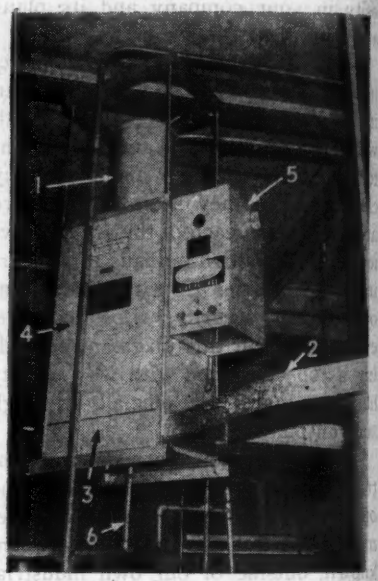
The above features are duplicated on the back of the symmetrical panel. Thus the panel can be used either on a single or double edge bench. The unit is also light enough and compact enough to be taken to any part of plant for test purposes.

TEST PANEL incorporates all receptacles needed to test portable electrical tools at North American Aviation's Texas Plant. Here, H. S. Skinner of the electrical maintenance department uses it to test a drill.

ELECTROSTATIC REMOVAL OF OIL COOLANT MIST

INDUSTRIAL

The choking suspension of oil coolant mist present wherever high speed metal cutting and grinding tasks are performed in industry has become a serious problem from the standpoint of employee welfare, building and electrical maintenance and production. This is particularly true in plants working around the clock—where additional machine tools have been added; where existing exhaust fan systems have been overtaxed and hence unable to adequately supply the necessary volume of clean air to the area involved.



PRECIPITRON UNIT at each machine consists of exhaust fan (1) which draws oil mist from cutting tool area through ducts (2), mechanical filter (3), de-ionizing and collector plates (4) for which direct current voltage is supplied by power pack (5). Recovered oil returns to reservoir through gravity drain (6).

This condition was especially acute in the automatic thread grinding department of the Metro Tool and Gage Co., Chicago, manufacturers of precision tools and gages. Here, six large high-speed grinding machines were enclosed by wood and glass partitions forming a separate room. The oil mist problem in this area was solved by the application of individual electrostatic air-cleaner units (Westinghouse Precipitron) to each grinder.

Each unit is rod-suspended from a

No. 7 of a series published by SYLVANIA for users of fluorescent lighting

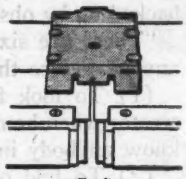
Fluorescent operating hints

METHODS OF MOUNTING FLUORESCENT FIXTURES

It's a good idea to be sure that the fluorescent fixtures you buy will be adaptable to the type of hanging necessary for your installation. Below are shown and described nine typical mounting methods.

SURFACE MOUNTING

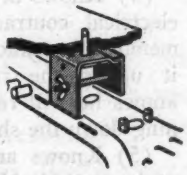
Most commercial fixtures can be bolted to ceiling mounting plates, Fig. 1, which are screwed to wood ceilings or toggle-bolted to plaster. Surface mounting is most popular where ceilings are low or unobstructed by pipes, beams, etc. Otherwise pendant mounting is used. (Note: Industrial type fixtures can be surface-mounted by using slide-grip hangers, Fig. 2, which are described under pendant mounting.)



(Fig. 1)

Surface Mounting With Slide Grip

Slide-grip hanger, Fig. 2, is fastened to ceiling with bolt or lag screw. It grips the lengthwise grooves in the top-housing at almost any point.



(Fig. 2)

PENDANT MOUNTING

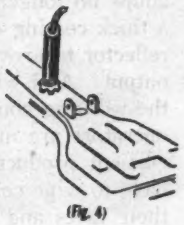
There are two basic methods of pendant mounting:

(a) The supporting chain, Fig. 3, or conduit, Fig. 4, is fastened directly to the top-housing. Advantage: low cost. Disadvantage: if obstructions at the ceiling prevent a straight run of chain or conduit from fixture to ceiling, the fixture must be moved until a clear position is reached. This may not be the best position for lighting the work.

Direct with Chain Suspension

The chain from the ceiling is fastened with S-hooks to the pair of hanging-brackets at each end of the top-housing.

(Fig. 3)

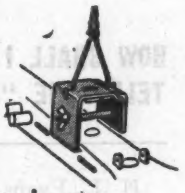


(Fig. 4)

Direct with Conduit Suspension

Threaded conduit with lock nuts is fastened to ceiling beam or outlet box. The other end enters the top-housing through knock-outs. Ornamental canopies are sometimes used at the ceiling end of the conduit.

(b) To overcome ceiling obstructions, the top-housing of some fixtures is grooved on both sides to accommodate a pair of metal clamps, which can be fastened at almost any point along the grooves. Then the hanging device (chain, etc.) is fastened to the clamp. This permits the hanging device to be fastened at the most practical point on the ceiling and permits the fixture to be placed at, or close to, the best point for illumination. Various methods of using these slide-grip hangers are shown below.



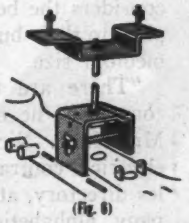
(Fig. 5)

Slide-grip with Chain

S-hooks fasten the chain to the slide-grip. Fig. 5.

Slide-grip with Rod and Ceiling Aligner Bar

A threaded 5/16"-diameter rod is fastened to the slide-grip with a nut, Fig. 6. At the ceiling, a U-shaped ceiling aligner bar is fastened with lag screws or expansion bolts. The free end of the rod is fastened to the aligner bar with a nut. This insures accurate vertical and horizontal alignment of rows of fixtures.



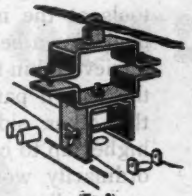
(Fig. 6)

Slide-grip with Messenger Cable

Instead of vertical supports, messenger cable parallel to the floor may be used to support fixtures, Fig. 7. Slide-grip hangers can be supplied with a cable clamp for mounting the fixture in line with, or at 90° to, the cable.

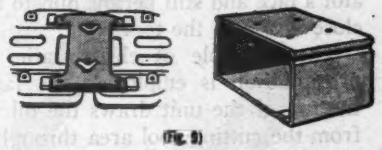
(Fig. 7)

To offset sagging in the cable, the cable-clamp is bolted to an inverted ceiling aligner bar, Fig. 8. This bar is bolted to another, which in turn is bolted to the slide-grip. Drawing up the bolts that join the two aligner bars permits the fixture to be made level with others in same row.



(Fig. 8)

CONTINUOUS ROW MOUNTING



(Fig. 9)

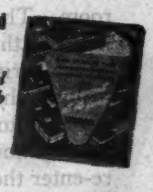
Where continuous rows of fixtures are desired, individual fixtures may be joined along the top-housing with joining straps, Fig. 9, which also provide continuous wireway enclosures. End plates are used at the ends of each row.

ADAPTABILITY IS IMPORTANT

Sylvania Industrial Fluorescent Fixtures are designed so that they can be mounted by *any* of the methods described above. This makes them fully adaptable to all conditions in your plant and permits reuse if remodeling alters ceiling layout.

For Additional Fixture Data, Send For The Free Booklet:

"How to Solve Your Industrial General Lighting Problems with Fluorescent at Its Finest"

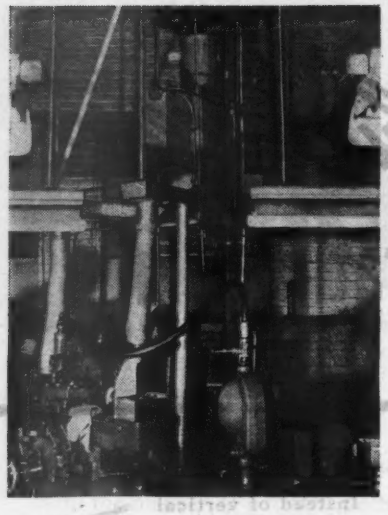


One Standard—The Highest Anywhere Known

SYLVANIA ELECTRIC PRODUCTS INC.

SALEM, MASSACHUSETTS

FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, INCANDESCENT LAMPS, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES



COMPACT ELECTROSTATIC air cleaning unit is mounted above a high speed automatic thread grinder. Flexible duct connections are at cutting tools and can be shifted to permit setting up the work. Rigid duct draws fumes from drip pan return to reservoir. Unit cleans air and recovers one quart of oil coolant per day.

ceiling mounted bracket directly above the grinder (see photo) with intake ducts leading to the cutting or grinding tools at the machine. One duct extends down behind the cutting tools to retrieve oil in the air as it splashed into the return pan; the other duct is on the other side of the cutting tool, higher up to catch the oil spray which ordinarily would be thrown into the surrounding atmosphere. Shields of sheet plastic mounted between the cutting tool and the operator prevent the oil coolant from spraying into the operator's face and still permit him to keep close watch at the tool point.

The principle of electrostatic dust precipitation is employed. A fan at the top of the unit draws the oil mist from the cutting tool area through the connecting ducts, through a mechanical filter at the base of the Precipitron to remove large particles both solid and liquid. The oil-laden air is then passed through an electrostatic field at the front of the unit which charges all dust, dirt and oil particles as they enter. The air is then drawn through a system of parallel plates of opposite polarity. The charged particles are drawn to the negative plate and the cleaned air, free of oil and dirt (cleaning efficiency of unit is approximately 90 percent), is then recirculated throughout the room. The particles of oil accumulating on the plates form large drops which drip off the plate, pass back through the mechanical filter to a drain at the bottom of the Precipitron and by gravity flow through a pipe connection re-enter the oil coolant reservoir of the machine.

An integral power pack mounted to the side of the air cleaner unit provides the direct current de-ionizing voltage of 13,000 and a d-c voltage of 6,000 for the collecting plate. In this installation, control switches for the operation of the exhaust fan and Precipitron are bracket-mounted to the bottom of the air-cleaner case within easy reach of the operator. Pilot lights on the face of the power pack enclosure indicate normal operation, short circuits, or grounds.

Since this installation was made the task of cleaning walls, ceilings, floors, lighting fixtures and lamps has decreased tremendously. The fluorescent lamps no longer have to fight against a thick coating of oil on the lamp and reflector to provide the necessary light output. And what is more important, the working conditions of the machine operators are much more favorable to efficient production. They no longer have to wipe coatings of oil film from their faces and arms—coatings which frequently clogged the pores of the skin —and they no longer are inhaling air that is heavily laden with suspended particles of the oil mist. Actual oil recovered from the air and returned for re-use at the cutting tool averages about one quart per machine for every 24 hours of operation.

HOW SHALL I USE THE TELEPHONE "CLASSIFIED"?

OFFICE METHODS

H. L. Evans, one of the principals of the Nicholas Electric Co., Hollywood, Calif., has made a study of the subject of telephone directory advertising over a period of years. Having tried various forms ranging from the mere bold face listing to large display advertising, he has come to what he considers the best use of space as applied to their business, which is one of medium size.

"There are two principals in the company", he explained, "myself and Mr. H. C. Nicholas." In the list of electrical contractors in the Los Angeles directory, at the point of the company alphabetical, bold face listing, are carried four additional lines (one-half inch) designating the type of business, expert workmen and reasonable prices, followed by the address.

"Under my own name, in bold face type, at its proper alphabetical point, which is two pages from the other, nine additional lines are carried, embodying the same information in addition to two additional lines to the effect that we are 'Hollywood-Wilshire Electricians', tying us in with the locality and another line on floor plugs and outdoor lighting. In this case, the name Nicholas Electric Co. appears at the end just before the address.

"Since the name of the company starts with Nicholas there is no need of carrying other than the company name at that point. If his name did not appear in the company name, then he also would have his own bold face listing at its proper alphabetical location followed by a similar text advertisement. Following our plan, no matter how many partners or top flight officials there might be in a company, all would receive such listings under their own names, in addition to the listing of the company name.

"As it stands now, we have two entries in the list instead of one, and quite widely separated. My theory, backed up by observation is this:

"There are six primary reasons for anyone to use the classified list.

(1) To look for an electrical contractor when he needs one but does not know anybody in the business.

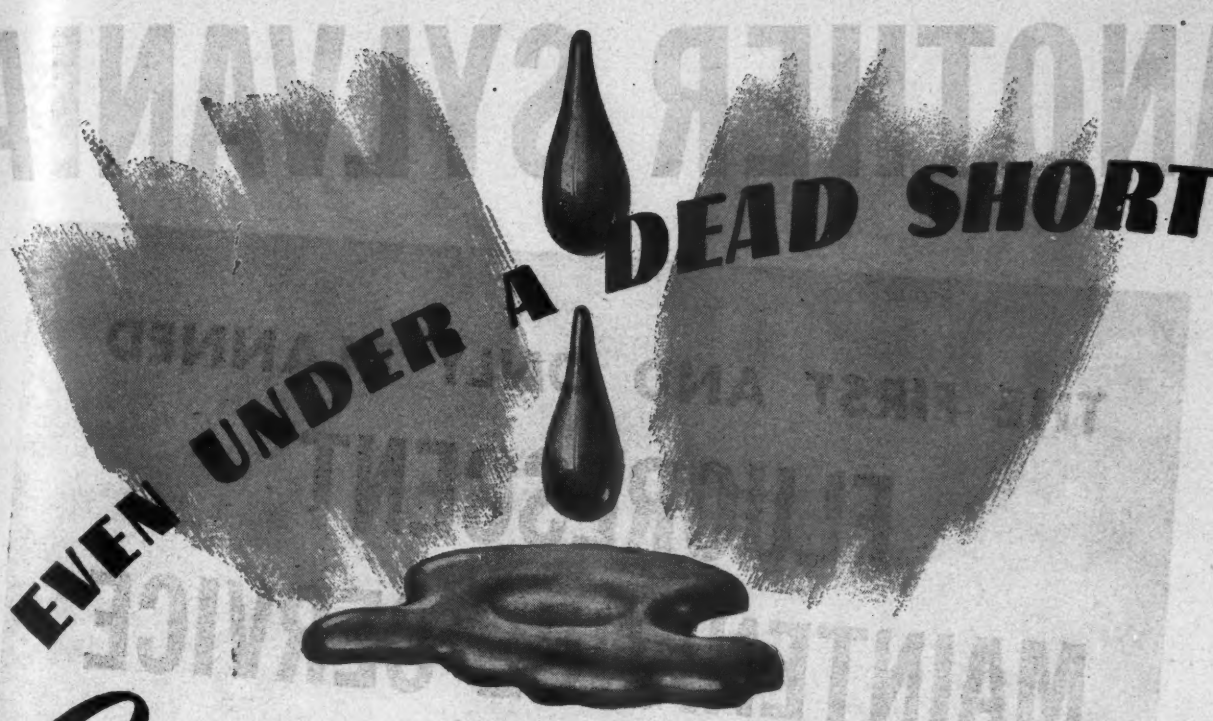
(2) To find out, by looking at the addresses, which contractor or contractors are located nearest to him.

(3) To see what classes of business various contractors cater to (industrial, residential, repair, etc.) and attempt to pick one whom he thinks best suited to his requirements.

(4) Knows of your firm as reliable electrical contractors but cannot remember the exact name so as to look it up in the regular directory but knows he will recognize it when running down the short classified list.

(5) Knows and has done business with an individual in the firm and

ELECTRIC TIME-DELAY relay (arrow) which times the period for grinding concentric bores in the stators of G-E tri-clad motors. One of many installed on grinding machines in this plant, this timer is preset so that after a certain period, depending on the amount to be ground and the size of the grinding wheel, it automatically stops the grinding operation.



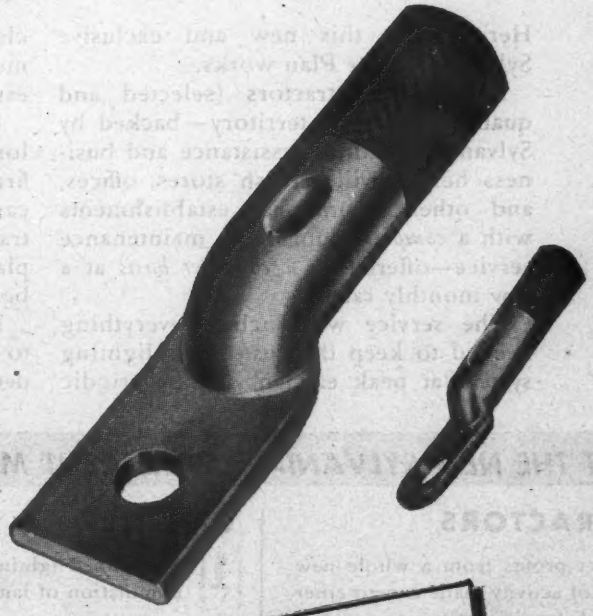
A HYDENT CONNECTION *Can't* LOOSEN OR MELT OUT!

The Burndy HYDENT connection is one point in the circuit that has caused no concern during this period of heavy overloads . . . when the "heat" really has been on. Being securely and permanently indented to the wire or cable with the Burndy HYTOOL, no loosening could occur even under a dead short!

It's this complete *freedom from worry about connector troubles* that has made the HYDENT connection so widely preferred not only by utilities and contractors but for electrical equipment as well. It provides a *permanent* connection, of high electrical efficiency, and it cuts installation time 50% to 90%.

HYDENT connectors, made in the form of lugs, links, reducers, taps, tees and crabs, are available for all wire and cable sizes. For complete information, write . . . Burndy Engineering Co., 107 Bruckner Boulevard, New York 54, N. Y.

IN CANADA: Canadian Line Materials, Limited, Toronto 13



Headquarters for CONNECTORS

Burndy

ANOTHER SYLVANIA

THE FIRST AND ONLY PLANNED FLUORESCENT MAINTENANCE SERVICE

A Brand-New Business-Building Plan for Electrical Contractors, Utilities, Jobbers!

Here's how this new and exclusive Sylvania Service Plan works.

Electrical contractors (selected and qualified) in every territory—backed by Sylvania's technical assistance and business helps—will furnish stores, offices, and other commercial establishments with a *complete* fluorescent maintenance service—offered *on a contract basis* at a low monthly rate.

The service will include everything needed to keep the customer's lighting system at peak efficiency . . . periodic cleaning of reflectors and lamps, replacement of lamps and other parts, and necessary repairs.

It's a service that stores and offices have long wanted. That's *proved* by the way firms already offering the service are cashing in on their maintenance contracts. Leading utilities have given the plan their enthusiastic approval . . . jobbers see prospects for increased sales.

Read below just what this plan means to *you* . . . then write to Sylvania for full details.

WHAT THE NEW SYLVANIA FLUORESCENT MAINTENANCE SERVICE MEANS TO YOU!

CONTRACTORS

1. Direct profits from a whole new field of activity made *easy* to enter with Sylvania's help.
2. Favorable contacts with fluorescent *users*—opening the door to sales of larger installations.
3. An outstanding opportunity to build up prospect lists for the sale of other services or merchandise.
4. A powerful sales aid in approaching *new* prospects for fluorescent lighting installations.

UTILITIES

1. Maintained lighting load—through elimination of lamp outages.
2. Relief from nuisance service calls from commercial customers wanting additional fixture repairs.
3. More favorable user-reaction to high-intensity fluorescent—paving the way for additional installations and more power sales.
4. The assurance that firms offering the service are backed by Sylvania's technical assistance.

JOBBERS

1. An immediate increase in lamp replacement sales for you and your electrical contractors.
2. A new sales feature for you and your electrical contractors to use in promoting fluorescent lighting among commercial prospects.
3. A powerful selling aid in the enthusiastic reaction of public utility lighting experts.
4. Opportunities for increased sales of allied equipment to concerns being serviced by this plan.
5. Opportunity to be of added service to your contractors.

A FIRST!

CONTRACTORS OFFERING THIS NEW SERVICE WILL DISPLAY THIS EMBLEM

SYLVANIA FLUORESCENT LIGHTING MAINTENANCE SPECIALISTS

STEP RIGHT INTO THIS WIDE-OPEN MARKET WITH THIS 5-POINT SYLVANIA PROGRAM

TECHNICAL ADVISORY SERVICE

Sylvania offers to contractors technical information and guidance . . . training assistance for electricians and mechanics.

OPERATIONS SYSTEM

Supplies of contract and maintenance record forms . . . assistance in analyzing installations, figuring costs and rates.

SALES INSTRUCTION

Details of a field-tested sales program . . . local sales and engineering help on your larger prospects.

PROMOTION MATERIAL

Insignia for your store front and trucks . . . suggestions for your letters . . . cuts for letterheads and newspapers.

TESTED AND PROVED DIRECT MAIL

Letters with return feature and reply cards . . . self-mailers and folders with *your* signature . . . at minimum cost to you.

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., SALEM, MASSACHUSETTS

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES, INCANDESCENT LAMPS, RADIO TUBES, CATHODE RAY TUBES, ELECTRONIC DEVICES

would like to deal with him again but does not know the name of the firm. Hopes he will get a hint out of the classified.

(6) Is in need of a contractor but does not know the field. Thinks he will look over the display ads and perhaps select one using large space, on the theory that the large space users are the best and most reliable.

"A study of these requirements will show that our method of using small explanatory space in as many places as the company name and partners or top flight personnel will permit will fit the first five of the requirements as well or better than any other method. It is the only one, in fact, that will fit No. 5. "That leaves only No. 6 that our plan does not cover. We feel that we are getting better results from the plan described, and minus the larger financial burden that the large space entails.

BRAZING NON-FERROUS JOINTS

INDUSTRIAL

Three of the four basic methods of brazing on a production basis with phos-copper, a special brazing alloy, are shown in the accompanying series of photographs of operations in plants of the Westinghouse Electric and Manufacturing Company. These methods are: gas brazing, using an oxy-acetylene torch (it is the most widely used and most flexible method of heating the parts to be brazed), incandescent carbon brazing, which uses a minimum of brazing alloy; and electric furnace brazing, which is ideally suited to heating a wide variety of parts.

The fourth type of brazing is accomplished by two methods—metal

FIG. 1—Gas brazing

FIG. 2—Incandescent carbon brazing

bath or chemical bath. These baths may be heated by gas or electricity. In the metal bath, filler metal is obtained from a molten bath of brazing alloy. In the chemical bath, parts are brazed by preplacing the brazing material before immersing in the heated bath. In the chemical bath, parts are jigged to hold them firmly together until after the assembly has been removed from the bath and the brazing alloy has solidified.

In Fig. 1, gas brazing is used in brazing the diaphragm on a copper flange assembly for condensor bushings. With this setup, a strong leak-proof joint is made with a gas torch in only a few seconds.

Fig. 2 shows incandescent carbon brazing. Here the worker brazes terminals to a-c welder leads with portable welding tongs. Heat is generated in carbon electrodes and transferred to the work by conduction. Joints are heated and cooled under pressure, insuring strong joints with a minimum of brazing alloy. No jig is needed as the tongs are clamped to the joint member with enough pressure to insure good contact and prevent movement of members in heating and cooling.

Fig. 3 shows electric furnace brazing. The special brazing alloy is preplaced and upon being heated to the melting point,in the presence of a reducing protective atmosphere, is drawn into the joint by capillary action resulting in strong uniform joints. The protective atmosphere prevents oxidation during heating and cooling, and produces clean, bright joints of excellent appearance.

An interesting use of the brazing is shown in Fig. 4 where it supplements regular spot welding procedures to facilitate production. Advantages are lower heat, faster operation and elimination of special joint preparation.

FIG. 4—Brazing with spot welder

FIG. 3—Electric furnace brazing

★ BETTER WIRING FOR BETTER LIVING ★

Anyhow, Christmas comes but once a year!

SPEAKING of embarrassing moments—Bill Bjones' greeting to his Yuletide guests is awkward, to say the least.

It isn't at all funny to Mary either—while little Oswald is having a very merry Christmas, as you can see. And "Barkus" isn't helping the cause at all.

But this is likely to happen in any home that is *inadequately wired*—that does not have at least one duplex convenience outlet *for every 12 feet of unbroken wall space.*

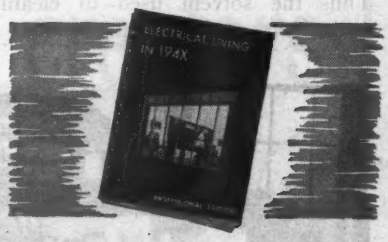
Long loose wires and temporary connections are more than a *source of embarrassment* to home owners, too.

They endanger the safety of the family and the home, as well. They cut down the efficiency of lighting and electrical appliances. And they waste electricity.

• • •

To help you make certain that the wiring in the homes you design or build after the war is brought up to 194X standards, the Westinghouse Better Homes Department offers you *free technical advice* on this important subject.

Refer your problems relating to home wiring, selection and installation of electrical equipment, location of convenience and lighting outlets and lighting controls, modern circuit protection, etc., to our housing specialists. You will receive *authoritative information*, promptly.



If you haven't already sent for your *free copy* of the new book, "Electrical Living in 194X" . . . which illustrates the proper wiring of every room in the modern home and the correct location of convenience outlets, switches, etc. . . . we suggest you do so *now!*

Write: Better Homes Department (EC-124) Westinghouse Electric & Manufacturing Company, Pittsburgh, 30, Pennsylvania.

Westinghouse

Plants in 25 Cities — Offices Everywhere

TUNE IN John Charles Thomas, *Sunday 2:30, EWT, NBC* . . . Ted Malone, *Monday, Wednesday, Friday 10:15 pm, EWT, Blue Network*

MOTOR SHOPS

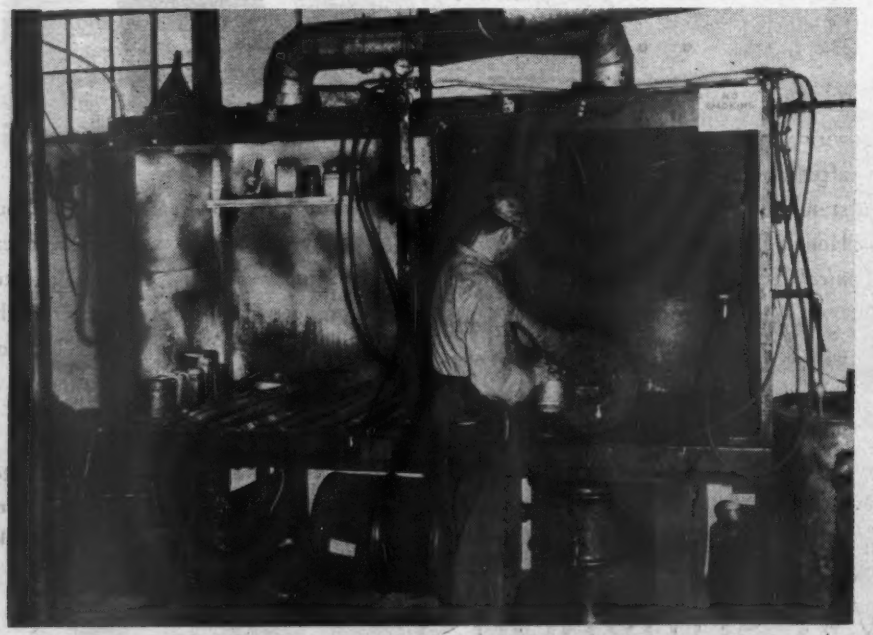
SIDE-BY-SIDE ARRANGEMENT OF PAINT AND CLEANING BOOTH

Since the paint spray booth and the cleaning booth both require compressed air and since both require some sort of exhaust equipment to expel fumes, it seems logical to place the two adjacent to one another. At least it seemed so to Walter J. Rider owner of a motor repair shop in Binghamton, N. Y. As a matter of fact Walter built one great big booth and put a partition in the center. One side is used for paint spraying, the other for cleaning.

As seen in the accompanying photograph, the ventilating ducts which draw fumes from the top center of each compartment merge into one duct that carries the fumes through a blower to the outside air.

The compressed air service is first piped through a Crown air filter and reducing valve which is mounted on the center partition. Air lines then emerge from the reducing valve in both directions, one to the painting booth and the other to the cleaning booth.

The table in the cleaning booth consists of a heavy fine-mesh screen laid over a closely spaced angle iron frame. Thus the solvent used in cleaning, drains into a settling tank below. An overflow pipe connects the settling tank with a storage tank from which a re-circulating pump carries the solvent back for re-use. Clean solvent is also supplied for final cleaning. Compressed air is introduced into the clean solvent tank forcing the fluid out through a spigot provided for that purpose in the wall of the cleaning booth.

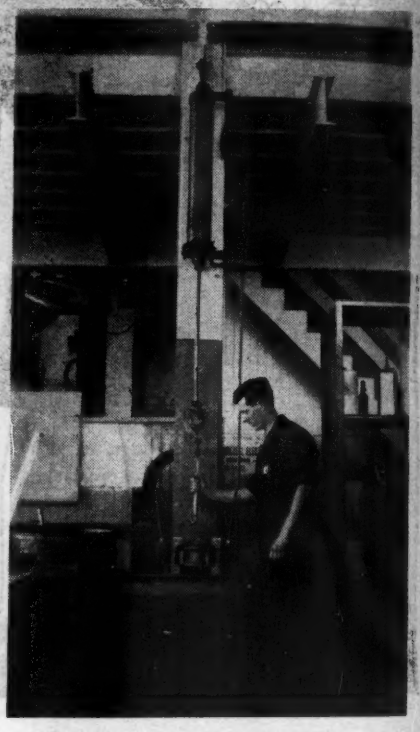


SIDE-BY-SIDE ARRANGEMENT of paint spray booth and cleaning booth saves running long service lines and duplication of facilities. Here one exhaust system and one compressed-air system serves both with a minimum of runs. Note air filter, reducing valve and gauge mounted on center partition.

AIR CYLINDER PULLS STATOR COILS

Buzzell Electric Co., San Francisco, has built a device for pulling coils on rotors that has exceptional power and control. It consists of a compressed air cylinder, which with its connections is mounted on one of the pillars in the shop as shown in the photograph. It is positive in action and operation of the piston is controlled by a foot lever by which the piston may be moved up or down with a fine degree of control. There is a hook on the end of the piston assembly to engage the coil.

The rotor is mounted on a steel bench below the cylinder and this bench is firmly screwed to the floor. Adjustable jaws are provided on the bench for securing the rotor.

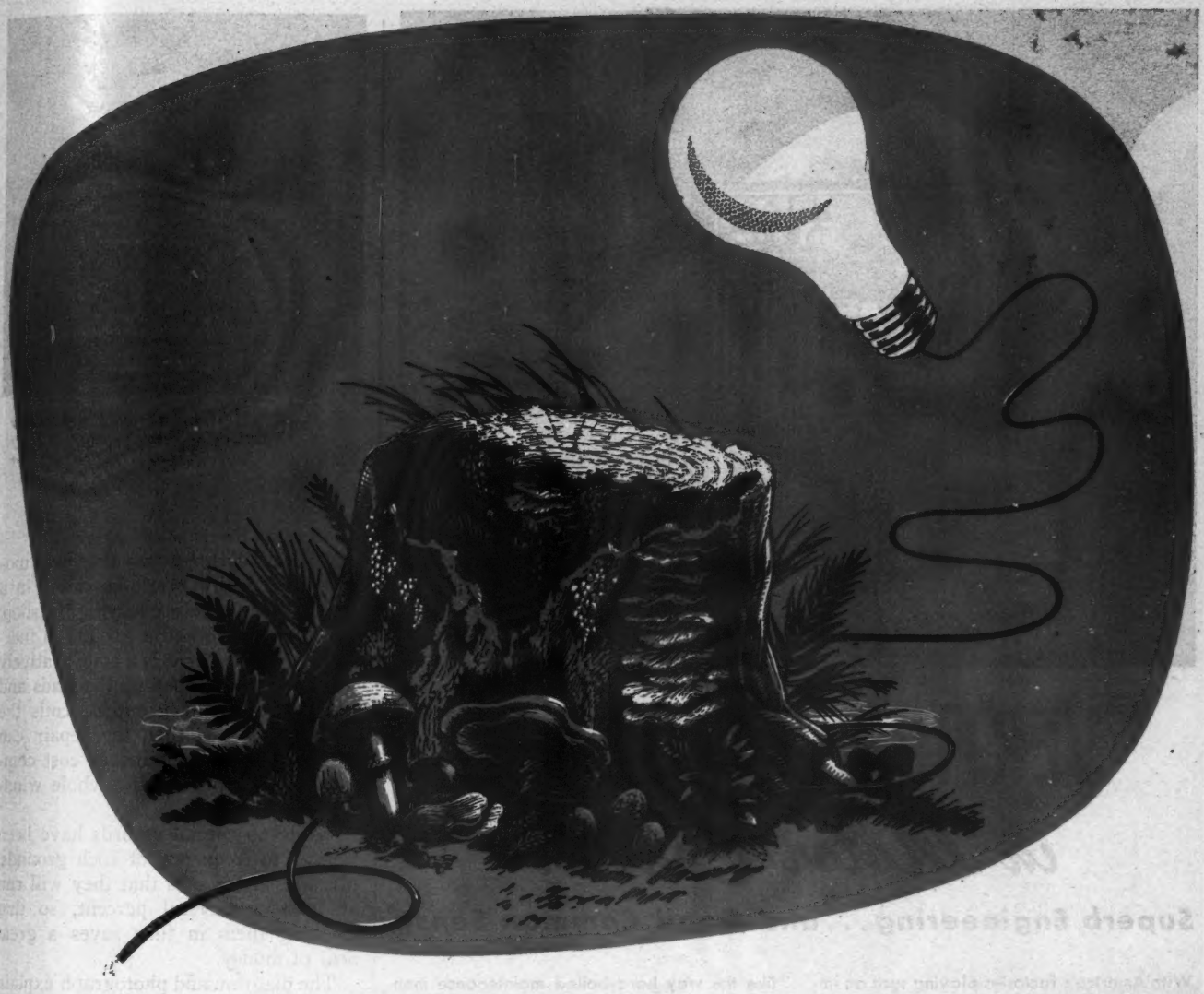


COMPRESSED AIR valved by a foot treadle into cylinder above pulls stator coils smoothly and quickly.

Aside from having great power (the cylinder is about six inches in diameter) the compressed air has the advantage that when the coil lets go there is no back-lash, the effect being dampened by "compression" on the other side of the piston.

COIL TESTER WITH CIRCUIT-BREAKER TRIP

R. L. Messinger, foreman ot the motor shop of the Smallcomb Electric Co., Los Angeles, is the designer and builder of a compact, portable tester for grounds in coil windings. It eliminates expensive lamp banks and the like. In explaining it, he reminds us that a rewound stator, for instance, must stand 2000 volts to ground. Occasionally a lamination will bend over between coils, or sometimes a coil will break in a slot. Without checking against such contingencies, a motor might be delivered and blow out at once in some damp location, with the result that the equipment would be returned for a new rewind and bake at



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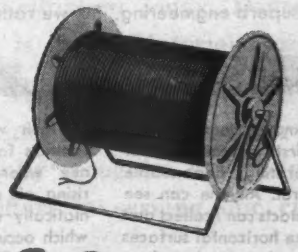

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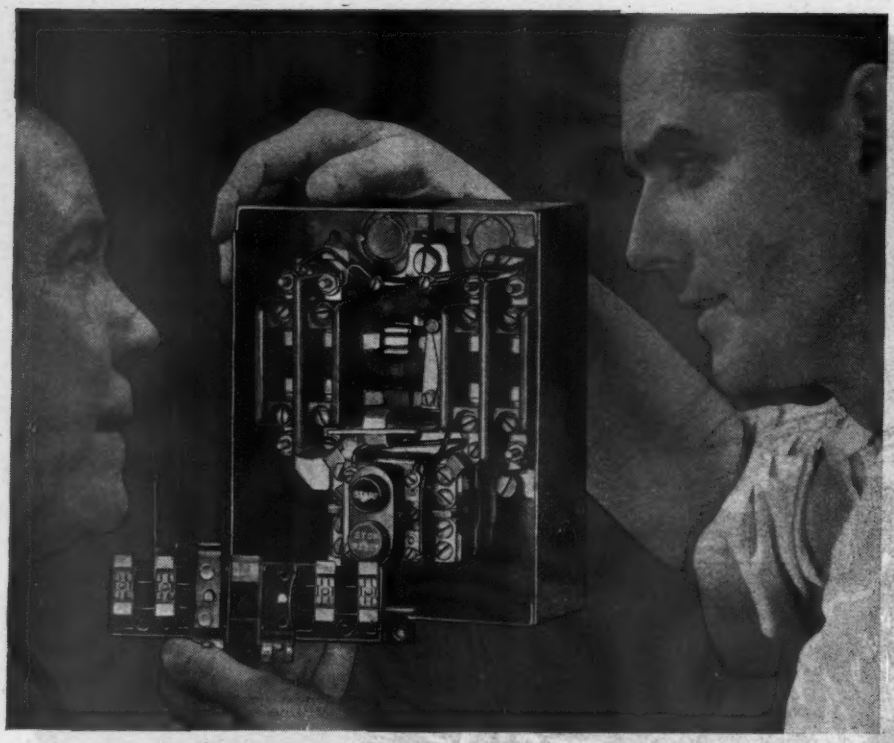

VERTICAL CONTACTS
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Superb Engineering... and Good Common Sense

With America's factories playing such an important part in shaping the future of mankind, *millions* of people know the vital job being done by electric motors and the resulting *importance* of dependable motor control. Thus the widespread preference for Cutler-Hammer Vertical Contact Motor Control is easily understood. Not only does the performance of *this* motor control speak for itself but the *reason* for such performance is obvious, easily appreciated, fully convincing. Electrical experts like to say the vertical contact construction in Cutler-Hammer Motor Control is superb engineering. But we rather like the way hard-boiled maintenance men put it... "Vertical Contacts make sense. I wouldn't buy any other kind of motor control". That tells the real story of an outstanding engineering achievement... why the vast majority of all electric motor manufacturers recommend Cutler-Hammer Motor Control, why leading machinery builders feature it as standard equipment, why a host of electrical wholesalers carry it in stock for your convenience. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.

Everyone knows *clean* contacts are the *first* requirement for smooth-operating, dependable motor control. Anyone can see vertical contacts *can't* collect dust and dirt like horizontal surfaces —must *stay* clean and perform better.

By their very design, vertical contacts form a flue or "chimney" wherein naturally induced rising air currents act to automatically extinguish the arcing which occurs when contacts are opened. This means longer-life motor control.

Vertical contacts are out in the open, easy to inspect, simple to service. They are designed to avoid the destructive effects of confined heat and arcing... do not merely *hide* them until major damage develops.

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Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

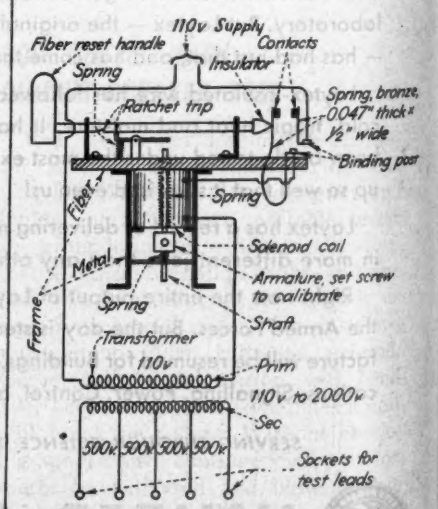
R. L. MESSINGER showing a portable ground tester which provides 2000 volt test potential in small compact unit.

expense of the repair company.

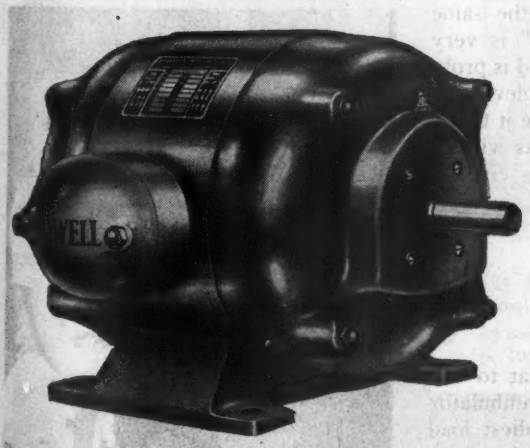
It is equally important that used motors taken in for resale be tested in a similar manner before leaving the shop. In either case, when a ground is indicated by the tester it is a comparatively simple matter to open up the leads and ascertain in what group of coils the trouble lies, and then the repair can be made at an insignificant cost compared with replacing the whole winding.

While no special records have been kept as to frequency of such grounds, Mr. Messinger says that they will run at least to several percent, so that catching them in time saves a great deal of money.

The diagram and photograph explain the details of the equipment which is contained in a box no more than ten inches in its greatest dimension. There is a transformer inside, with leads delivering 500, 1000, 1500 and 2000 volts from the secondary. In testing, the desired voltage is impressed through a circuit-breaker tripping device, so that no harm is done to the coil by the momentary contact.



CIRCUIT ARRANGEMENT and details of the ground test with rapid short circuit trip.



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron, weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available.

Available in sizes 5 H.P. and smaller.

The tens of thousands of owners who already have Howell Motors are "walking on air." Producers do like quality.

But, we all know the entire electric motor industry is confronted with a serious situation today. Demands for motors are up. Manpower is short. Materials are scarce.

While we are swamped with orders for Howell Motors, we have flatly refused to skimp on quality in order to speed production. However, we fully recognize our obligation to put forth the maximum effort in serving our customers NOW! This, we are doing.

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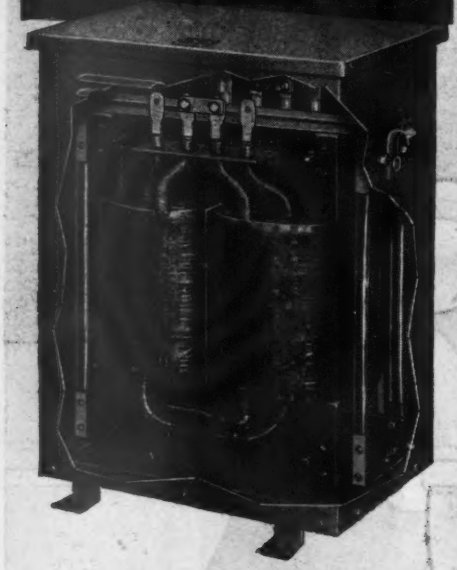
Manufacturers of Quality Motors Since 1915

DOLPH'S INSULATING VARNISHES



FOR EXTRA PROTECTION TO WINDINGS

Today it is most essential that transformers are built to withstand temporary power surges and deliver uninterrupted service. It is a known fact that these power surges can prove to be very detrimental to the varnish insulation on coil windings and will tend to lessen the useful service of your equipment.

No matter what type of electrical units you manufacture, you will find a DOLPH Insulating Varnish formulated to do a better job by providing the extra protection under severe operating conditions. Why not let us help you with your insulating varnish problems.

The above cut-away photo is a 50 K.V.A. Air Cooled Transformer manufactured by Jeffries Transformer Company.

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VARNISH AGITATORS

Stirring varnish with a paddle is no child's play and besides takes a lot of time. Enterprise Electric Co. of San Francisco does it instead by means of a glorified "food mixer" made from an electric drill with an extension on the shaft and a propellor blade on the end of the extension. The dimensions of

VARNISH MIXER uses small motor and propellor and may be hung over the side of the tank.

the propellor are about 10 inches in diameter with blades 1¼ inches wide, and the speed is such that it takes only a few minutes to stir up a tank of varnish when the propellor is just held submerged by hand.

The Buzzell Electric Co. also of San Francisco uses a device on the same principle, but the "propellor" is very much smaller, though the speed is probably higher. They hang the device on the edge of the tank and leave it there, the action not being quite as violent but keeping up a continuous circulation as long as desired.

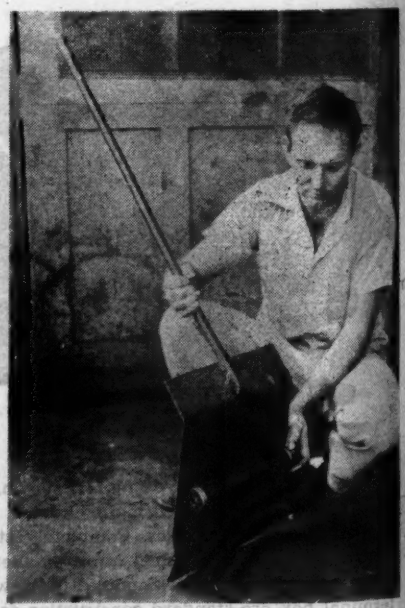
MOTOR PERAMBULATOR

"I don't know exactly what to call it—dustpan on wheels or perambulator—but it is the lightest, handiest load mover we ever had around the shop. Less than an hour was required to make it, but it will easily pick up a 40 hp. motor and go anywhere over concrete floors. With somewhat larger casters it would work on dirt floors." E. Shollin, proprietor of the All Star Electric Co., Los Angeles, was describing the device shown at right.

It consists of a piece of heavy gauge sheet steel approximately 14 in. by 18 in. with a pipe handle welded to the under side. On the bottom is welded an "H" frame of strap iron across which is welded another piece of conduit in the ends of which are set casters on ball bearings. The lower edge of the plate is bent at a slight angle as is the upper edge where the handle is attached.

Thrust the edge of the pan under the weight to be lifted, after tipping the latter up slightly, and then bear down on the handle until the pan carries the whole load. The principle is the same as that of the ordinary wheel hand truck, but the weight is little in comparison, takes up less room and handles loads up to several hundred pounds.

SHEET STEEL "SHOVEL", pipe handle and casters make a light, convenient load mover for the motor shop.



STRAP IRON welded to the bottom adds stiffness. A piece of conduit holds the ball bearing casters.

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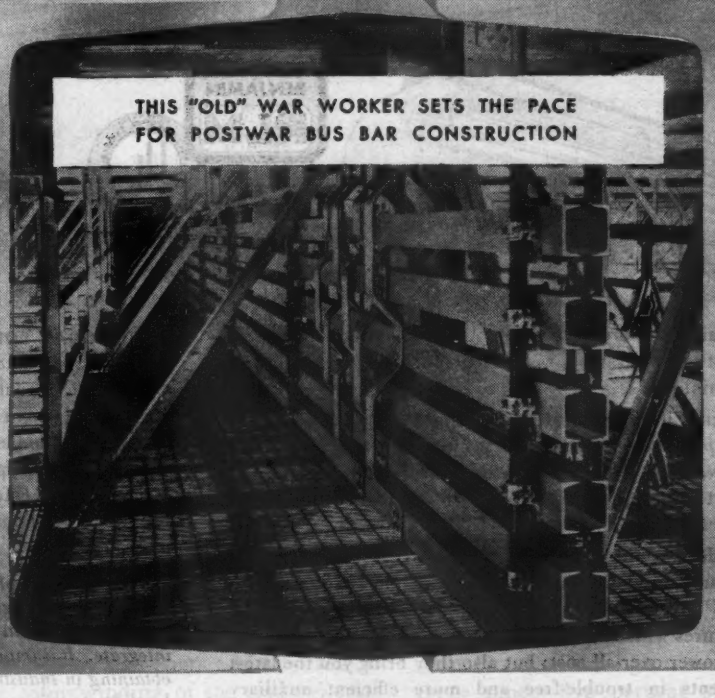
Less labor is required to install aluminum bus bars. Their lighter weight makes handling and erection easier. Supports can be similarly lighter and more widely spaced. Buses can, therefore, often be installed without expensive reinforcement of structures.

Alcoa engineers will gladly help select conductors and fittings for your bus installations. Write ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.



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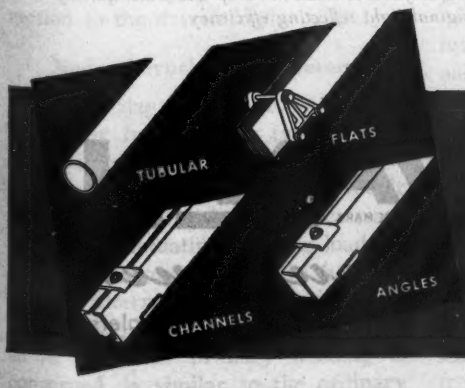
The idea of using structural shapes for electrical conductors was originated by Aluminum Company of America; better ventilation and higher efficiency, rigidity and strength of a girder. This first installation of channel bus bars, installed in 1928, has a run of 1,600'. Conductors are 5" Alcoa Aluminum channels.



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Not only do these units bring to you the extra safety factor of strength and durability insured by Benjamin's "built-like-a-battleship" construction; *the ease of installation and maintenance* features which have long identified Benjamin with economy and lower over-all cost; but also they bring you the latest developments in trouble-free and more efficient auxiliary equipment.

WRITE TODAY FOR NEW BULLETINS containing complete descriptions and data on the various Benjamin RLM Fluorescent Units now available. These include Twin and Triple Lamp closed and open-end units for both 48" and 60" fluorescent lamps; also, the Benjamin dust-tight and vapor-tight fluorescent units and the Type "V" non-metallic reflector Fluorescents. Write Product Information Department H, Benjamin Electric Mfg. Co., Des Plaines, Illinois.

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Selection and Application of Synchronous Motors—I

General considerations are discussed in this first article with special reference to operating characteristics including power factor, torques and flywheel effect.

By A. P. Burris,
New York District Manager
Electric Machinery Manufacturing Co.

THE synchronous motor was discovered as early as 1869, but only for the past twenty-five years has industry really taken advantage of the characteristics it offers. Two main factors were responsible for the reluctance of industrial engineers to apply synchronous drive. First, the manual type of starter, including the manual application of the exciting current to the motor field, required a capable and experienced operator. The application of field current to the motor before it reached the speed where it would pull into synchronism would often result in the motor stalling; and too long a delay gave objectionable line disturbance. Secondly, it has been only during the last two or three decades that design engineers brought out the necessary motor torques for many difficult applications. In fact, early synchronous motors often used a starting motor to bring them up to speed, while others started and synchronized unloaded, utilizing some type of clutch for connection to the driven load.

Modern Synchronous Motors

Present day synchronous motors, with their full-magnetic type of control which will be discussed in a later article, successfully handle difficult starting loads and those characterized by widely fluctuating running loads.

The synchronous motor is the third type of alternating current motor to be discussed in this series, and insofar as its stator or primary winding is concerned, is similar to the ordinary induction motor discussed in previous articles. The rotor, however, is built with an even number of projecting poles, each of which is wound with a coil much the same as the field pole in the stator of a d-c machine. These coils comprise the field winding and are so connected as in the d-c motor to alternately form north and south poles when excited with direct current. Around the periphery of the rotor is the *squirrel-cage* or *starting-winding* which consists of copper or alloy bars, through the pole tips, and connected to continuous end rings from pole to pole. In other words, the synchronous motor rotor has two separate and distinct windings; the squirrel-cage "winding", made up of rotor bars short-circuited by end-rings and identical to the rotor winding of the squirrel cage motor from which it gets its name, used solely for providing sufficient torque for starting; and the synchronous field winding made up of coil-wound poles continuously excited by direct current used to "lock" the rotor into synchronous speed.

Stator Winding

The stator or armature coils are connected to form the same number of pole groups as there are projecting field poles on the rotor. These stator magnetic pole-groups, when energized from the a-c power supply, revolve around the stator circumference at the "electrical" speed of the frequency of the power supply. At any instant of time, the pole-groups around the stator circumference are alternately north and south, and the number of such "poles" depend upon the mechanical speed for which the motor is wound.

If the rotor were removed, and a compass held near any point on the inside circumference of the stator (excited), the needle would alternately swing back and forth from north to south as the magnetic "poles" slid past the test point. This revolving magnetic field of the stator, through induction (transformer action), causes the rotor to start to revolve and accelerate toward synchronous speed. During this acceleration period, the field coils which have their leads brought out to collector rings and from there out through brushes, is short circuited through a resistor. At about ninety-five percent speed, this resistor is disconnected and direct current excitation is applied to the field winding pulling the motor "into step" or into synchronism.

This synchronization occurs when each revolving field pole of the rotor becomes electrically locked to a pole of opposite polarity in the revolving magnetic field in the stator armature circuit.

Fig. 1 illustrates the fundamentals of a four pole, 1800 rpm., (on 60 cycles) synchronous motor. It is shown in partial cross section. Only part of the stator coils are shown.

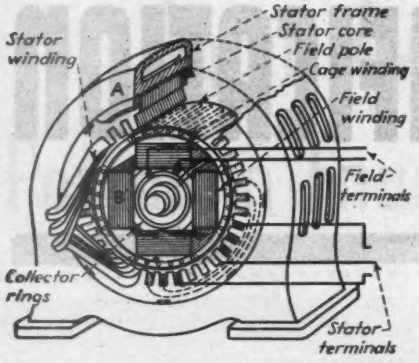


FIG. 1 — Cutaway section of synchronous motor showing the wound field poles and the squirrel-cage winding of the rotor. The field gets its continuous excitation from an external source through slip-rings.

Advantages of Synchronous Motors

There are three inherent synchronous motor characteristics that make them particularly desirable for many types of drive.

1. Their operating efficiency is higher than induction motors particularly through the range of medium and low speeds.
2. They operate at a leading or unity power factor as compared with the lagging power factor of the induction type.
3. Their speed is absolutely constant, without slip.

Fig. 2 compares efficiencies and losses of a 200 hp., unity power factor synchronous motor, and squirrel cage induction motor, at various operating speeds. This indicates an appreciable difference in losses, often *not* taken into consideration in evaluating the two types of motors. For example, an annual saving of $219.00 results from a 5 kw. reduction in loss on a motor that operates 50 percent of the time and at an electric energy cost of one cent per kilowatt hour.

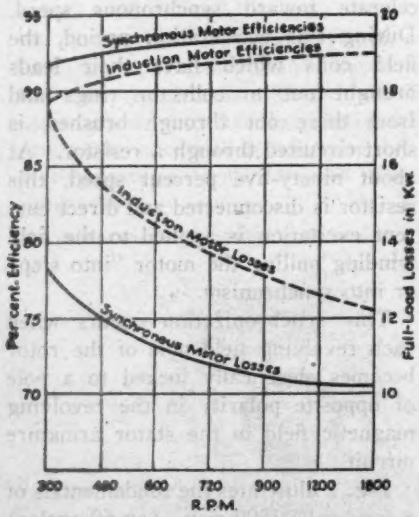


FIG. 2—Efficiencies and motor losses are compared for the induction motor versus the synchronous motor for different speed ratings.

Where efficiency of motor operation is a point of major importance, the unity power factor synchronous motor offers results that cannot be obtained in any other type of motor.

Again referring to a 200 hp. rating as a point for comparison, Fig. 3 shows the relationship between the full load power factor of synchronous motors (unity power factor), and induction motors, at various speeds. Where low plant power factor shows needed correction, the leading power factor synchronous machine would of course increase the differential.

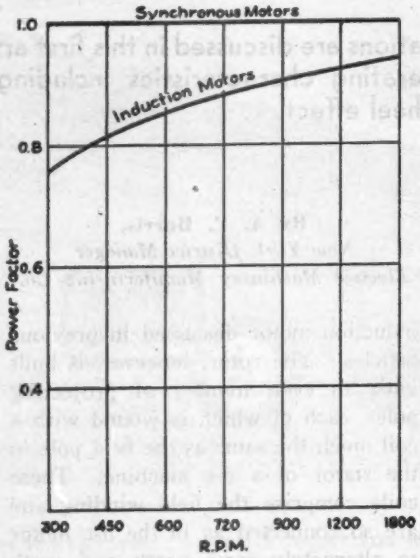


FIG. 3—Induction motor power factors are shown compared to those of the unity power factor synchronous motor for various speeds. The power factors shown are the full-load values for each speed rating.

The speed of a synchronous motor, line frequency remaining constant, never varies.

This constant speed of a synchronous motor, without any slip whatsoever, is of paramount importance in many drives. It gives a uniformity of product which might not be obtained if the speed varied due to varying slip under different load conditions.

Synchronous motor speed, expressed in revolutions per minute, is equal to the frequency multiplied by 120 and divided by the number of poles.

Operating Characteristics and Basic Considerations

Torques

There are four conditions of motor torque to be considered in the application of synchronous machines to a given load condition.

1. Starting torque
2. Accelerating torque
3. Pull-in torque
4. Pull-out torque

These more or less define themselves. The starting or breakaway torque is the effort exerted by the motor to break the load away from rest. It is the minimum torque which the motor will exert from any angular position of the rotor. The accelerating torque produced at any speed up to approximately 95 percent synchronous speed, in excess of the torque required to drive the load at that speed.

Pull-in torque is the maximum constant torque under which the motor will pull its load into synchronism when the excitation is applied. Pull-out torque is the maximum sustained torque which the motor will develop at synchronous speed with normal excitation. These torques are all expressed in percent of full load motor torque, and are based on rated voltage and frequency.

The leading power factor synchronous motor requires more stator and rotor iron and lower impedance circuits than a unity power factor motor of the same horsepower rating, and will thus inherently have higher starting, pull-in and pull-out torque.

Thus where high starting torque, pull-in torque and pull-out torque are governing requirements of the drive, the leading power factor motor is best adapted. Where a leading power factor motor is necessary for power factor correction, its high inherent starting and pull-in torques are available to help meet the requirements of the drive. Where the load fluctuates widely and rapidly, a leading power factor motor should be used, thus also making available the higher starting and pull-in torques. If high starting and pull-in torque only and not high pull-in torque nor power factor correction, nor load fluctuations are the governing requirements, an oversize unity power factor motor rather than leading power factor motor may provide the most economical design.

Fig. 4 illustrates three different synchronous motor applications for compressors, centrifugal pumps, and ball or tube mills. The approximate torques as required for these drives are indicated, together with estimated motor current for such torques.

In a synchronous motor, the starting and pull-in torque vary as the square of the primary voltage applied, while the pull-out torque varies directly as the voltage. On an induction machine, the pull-out torque varies as the square

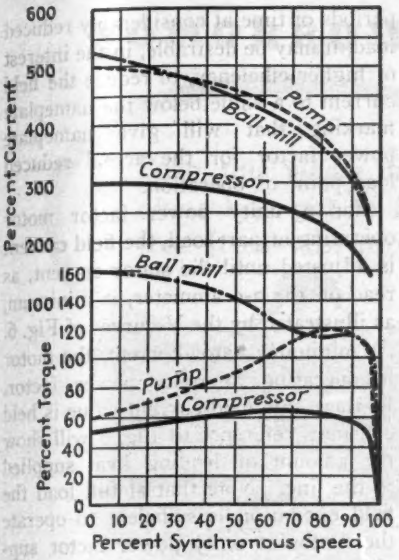


FIG. 4—Approximate torques required for three different types of drive are shown together with estimated motor currents to provide those torques.

of the voltage applied. Thus, on fluctuating loads having high peak torque requirements, a ten percent voltage drop would leave 90 percent pull-out torque available in the synchronous unit, but only 81 percent (.9 squared) on the induction machine.

Power Factor

The study of power factor in synchronous motors opens a subject on which much can be written. Whereas an induction motor operates at a lagging power factor and gets its excitation from the line, a synchronous motor operates at 100 percent (unity), or at leading power factor. It therefore helps to improve the plant operating power factor. Most public utilities have a power factor clause in their power contracts, thus making it advantageous to the consumer to keep his plant power factor up to a good value.

The two more generally used power factor ratings are unity and 80 percent leading. Other power factors are of course available if the load condition calls for them.

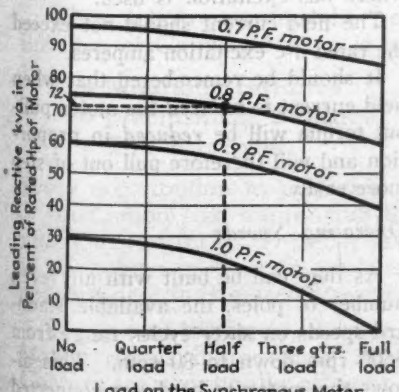


FIG. 5—Leading reactive kva. supplied by four variously power factor rated synchronous motors at various loadings with voltage and excitation currents remaining constant.

Fig. 5 shows curves approximating the leading reactive kva. from synchronous machines of four different power factor ratings, at varying load conditions, based on maintaining full load rated power factor excitation at all loads.

At half load, for example, a 100 hp. 0.8 power factor synchronous motor driving an air compressor supplies leading reactive kva. equal to (see curve) approximately 72 percent of its horsepower rating, or 72 rkva.

The unity power factor synchronous motor as shown by Figure 5 supplies leading reactive kva. only at part load. But at full load, although then providing no leading reactive kva., it still improves the power factor by adding to the kilowatt load without increasing the reactive kva. load. A unity power factor synchronous motor costs less than a leading power factor synchronous motor of the same horsepower rating because less material is used in its windings and magnetic parts. Highest efficiency is also obtained with a unity power factor synchronous motor. But when considerable power factor improvement is required, leading power factor synchronous motors are generally preferable.

Leading power factor synchronous motors cost somewhat more than unity power factor motors of equivalent horsepower rating because their stator and field members are built to generate and carry leading reactive kva. as well as mechanical load, and because of larger size, their efficiency is somewhat less than that of unity power factor motors. The extra cost and lower efficiency are generally widely offset, however, by the reduction in cost of electric power obtained by maintaining high power factor.

As an estimating rule: each horsepower of 0.8 power factor synchronous motor, operating at full load and rated excitation, will supply the lagging reactive kva. for 1 1/3 horsepower of highspeed induction motors. Thus a 150 hp., 0.8 power factor synchronous motor will correct to unity power factor approximately 200 hp. in high-speed induction motors.

Excitation

If the field current of a synchronous motor driving a constant load is varied, the stator current varies, following the characteristic V-curves illustrated in Fig. 6. For a given load (with a given

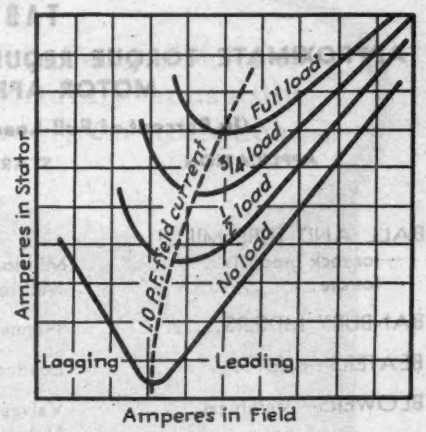


FIG. 6—Typical V-curves of a synchronous motor show how the stator current varies as the field current is varied. Note that minimum stator currents are obtained at unity power factor, at which point reactive current is zero.

motor) there is a single value of field current that will give unity power factor at the motor terminals. Increasing or decreasing the field current from this value will give a power factor less than unity—increasing the field current will give "leading" power factor, decreasing the field current will give "lagging" power factor. Stated another way, for a given load with constant voltage, if the field current is changed either way from the unity power factor value, "reactive" current will be produced causing the line current to increase as shown in the V-curves. This reactive current will be "leading" if the field excitation is increased, or "lagging" if decreased.

The V-curves in Fig. 6 show that the minimum armature current for a given load is at unity power factor, the field current for which is indicated by the dotted line.

Field excitation for the synchronous motor is secured either from an individual induction-motor-driven exciter set, a direct-connected, or belted exciter, or a constant d-c voltage supply such as a station bus. Standard excitation voltage is 125 volts or 250 volts, but the motor field winding is designed for an excitation voltage approximately 10 percent below this, to allow for voltage drop in the line.

In operation of the motor, the field current is usually set at the value of d-c excitation amperes stamped on the motor nameplate, and kept at this value at all loads. Maintaining full-load nameplate excitation on the motor field maintains the full pull-out torque of the motor, and at the same time gives the maximum amount of reactive kva. for power factor correction.

If the motor is to be run for long

TABLE I

APPROXIMATE TORQUE REQUIREMENTS OF SYNCHRONOUS MOTOR APPLICATIONS

(In Percent of Full-Load Torque of the Motor)

APPLICATION	STARTING CONDITIONS	PERCENT TORQUES		
		Starting	Pull-In	Pull-Out
BALL AND TUBE MILLS				
—for rock products	Mill loaded	160	105	150
—for ore	Mill loaded	175	105	150
BANBURY MIXERS	Normally unloaded	125	125	250
BEATERS—pulp	Loaded	140	110	150
BLOWERS—centrifugal	Valves closed	50	110	150
	Valves open	50	110	150
BLOWERS—rotary	By-passed	50	50	150
CHIPPERS	Unloaded	60 to 125	50 to 110	250
COMPRESSORS—centrifugal	Valves closed	30	60	150
	Valves open	30	110	150
COMPRESSORS—reciprocating				
—air and gas	Unloaded	40	40	150
—ammonia	Unloaded	40	40	150
—carbon dioxide	Unloaded	50 to 80	40	150
—freon	Unloaded	40 to 50	50 to 60	150
EDGERS	Unloaded	50	50	250
FANS—centrifugal	Valves closed	50	75	150
	Valves open	50	110	150
FANS—sintering	Gates closed	50	115	150
FANS—propeller		50	115	150
FLOUR MILL, lineshaft	Loaded	160	110	150
GAS WASHER	Unloaded	50	110	150
GRINDERS, pulp	Unloaded	50	50	150
HAMMERMILLS	Unloaded	125	110	250
HOGS	Unloaded	125	100	250
JORDANS	Unloaded	50	50	150
	(Short plug movement)	75	110	150
PLASTICATOR, rubber	Unloaded	140	110	250
PUMPS—centrifugal	Disch. valve closed	30	60	150
	Disch. valve open	30	105	150
PUMPS—reciprocating	By-passed	40	40	150
	Not by-passed	150	105	150
PUMPS—screw	Started dry	40	40	150
	Primed	60	110	150
ROD MILLS	Loaded	175	105	150
ROLLING MILLS				
—structural, billet merchant rod, sheet and plate	Unloaded	50 to 100	50 to 100	250 to 300
—tube piercing, rolling and reeling	Unloaded	50 to 100	60	250 to 300
—cold roll sheet	Unloaded	200	125	250
—brass and copper	Unloaded	50	40	250
RUBBER MILL LINES	Normally unloaded	80 to 125	100 to 125	250
SAWS—band	Unloaded	125	75 to 115	250
—gang	Unloaded	100	50	150
—trimmer	Unloaded	100	75	150

periods of time at considerably reduced load, it may be desirable, in the interest of higher efficiency, to reduce the field current to a value below the nameplate marking that will give nameplate power factor for the actual reduced load point of operation.

For a unity power factor motor operating at part load, the field current is adjusted until the stator current, as read on the a-c ammeter, is minimum, as illustrated by the V-curves of Fig. 6. At minimum stator current, the motor is operating at unity power factor. If, then, this field current value is held constant, reference to Fig. 5 will show the amount of leading kva. supplied to the line. Note that at full load the field excitation is sufficient to operate the motor at unity power factor supplying no rkva. However, at half load, it supplies about 22 percent of the numerical value of the motor's horsepower rating expressed in leading reactive kva.

For a leading power factor motor operating at part load, the field current is first adjusted for minimum stator current, or unity power factor, and the minimum line current noted. The field current is then increased so that the stator current rises along the V-curve to the value required for the desired leading power factor as determined by the following formula:

$$\text{Stator current for desired p.f.} = \frac{\text{minimum stator current}}{\text{desired p.f.}}$$

Thus, if the minimum stator current reading is 100 amp. and desired leading power factor is 0.8, the field current should be increased until the stator current is $100 \div 0.8 = 125$ amps.

The necessary field current adjustment is secured by the exciter field rheostat where individual exciter set, direct-connected or belted, is used; or by a motor field or "series" rheostat where bus excitation is used.

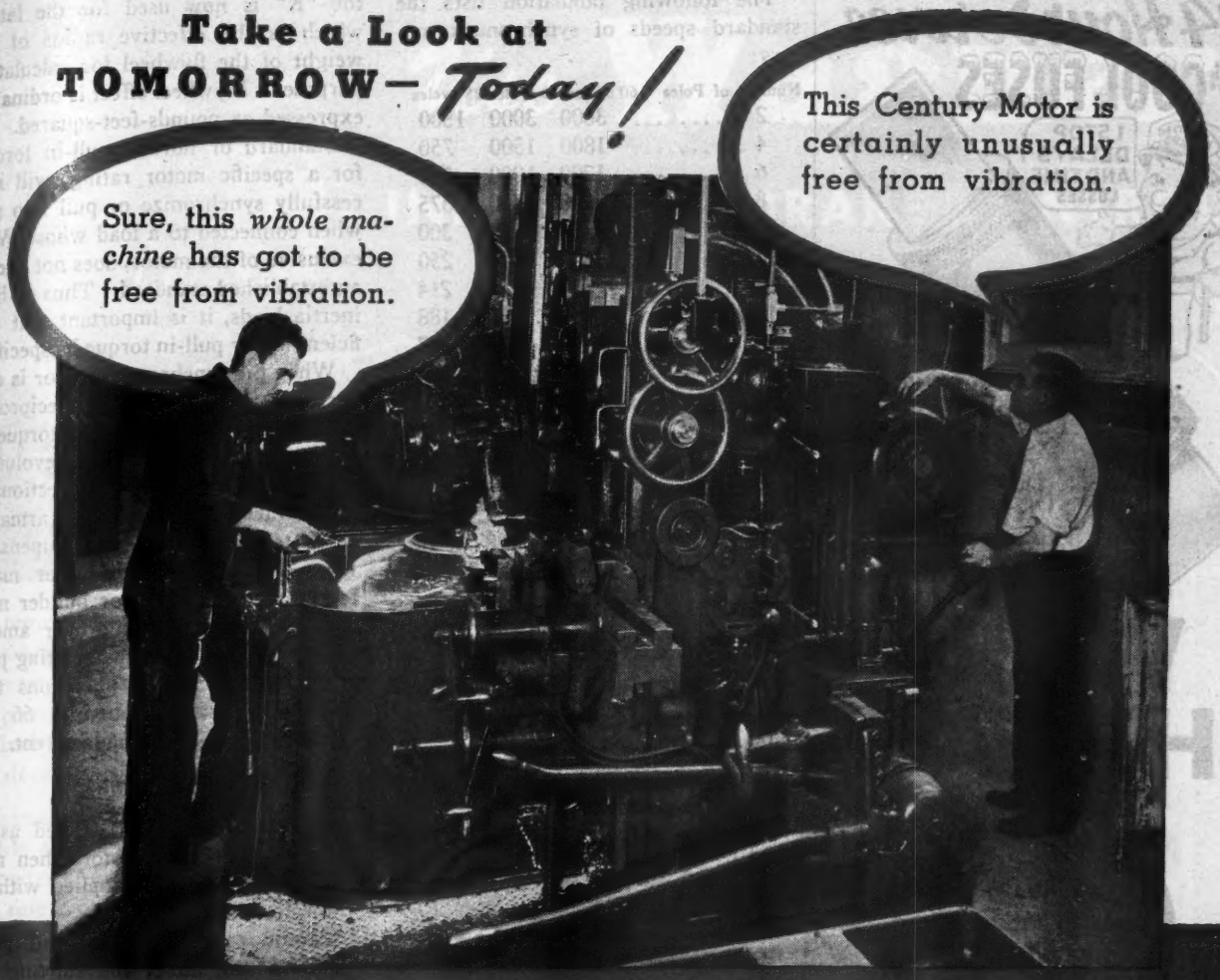
The field current should not exceed the rated d-c excitation amperes.

It should be remembered that when field current is ***reduced*** the motor pull-out torque will be ***reduced*** in proportion and will therefore pull out of step more easily.

Operating Speeds

As they can be built with any even number of poles, the available standard speeds on sixty cycles range from 3600 rpm down to 80 rpm. This allows the motor to be direct connected to its load, even at the lower speeds, where induction motors cannot be advantageously used because of low operating efficiency and power factor.

Take a Look at TOMORROW— *Today!*


Sure, this *whole machine* has got to be free from vibration.
This Century Motor is certainly unusually free from vibration.

CENTURY MOTORS' Unusual Freedom From Vibration Contributes to More Accurate Machine Tool Performance

The unusual freedom from vibration of Century Motors matches the precision and accuracy of the thousands of machine tools they drive.

Determine for yourself — put your fingertips on a Century Motor and you'll hardly realize it's running — because of its quiet operation and solid feel.

When tolerances must be held to the closest limits, the rotational balance of Century Motors is all-important, including:

- Magnetic Balance
- Mechanical Balance
- End Bumpers
- Rugged Frames
- Accurately Machined Feet
- Extreme Rigidity

Every contribution to precision workmanship, to increasing the speed of production and decreasing the number of rejected pieces is particularly important today under the demands of War. It is important, too, in peacetime production, as tolerances grow finer and advanced engineering demands extreme precision work.

Today and tomorrow, the unusual freedom from vibration of Century Motors grows increasingly important. It will pay you to remember Century for practically all your future motor applications — from fractional to 600 horsepower.

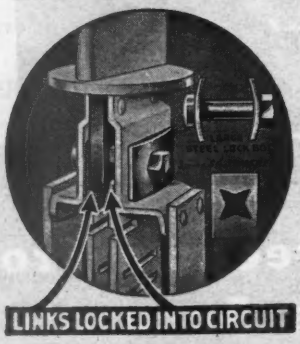
Century MOTORS 345

CENTURY ELECTRIC CO., 1806 Pine St., St. Louis 3, Mo.

Offices and Stock Points in Principal Cities

24 Hour Service with COOL FUSES

WARE HI-LAG



NON-HEATING CONTACTS

Keep Motors Humming

100% Quality

APPROVED BY UNDERWRITERS

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WARE Renewable HI-LAG FUSES

The following tabulation lists the standard speeds of synchronous motors:

Number of Poles	60 cycles	50 cycles	25 cycles
2	3600	3000	1500
4	1800	1500	750
6	1200	1000	500
8	900	750	375
10	720	600	300
12	600	500	250
14	514	428	214
16	450	375	188
18	400	333	167
20	360	300	150
22	327	273	136
24	300	250	125
26	277	231	115
28	257	214	107
30	240	200	100
32	225	188	94
36	200	167	83
40	180	150	
44	164	136	
48	150	125	
52	138	115	
56	129	107	
60	120	100	
66	109	91	
72	100	83	
80	90		
84	86		
90	80		

Voltage

For synchronous motors 200 hp. and smaller, the standard voltages are 220, 440, 550 and 2200. Larger units have standard ratings of 2300, 4000, 6600, 11000, and 13200 in addition.

As synchronous motors are generally custom built for the application on which they will be used, it follows that they can be obtained for any specific operating voltage as required.

On the basis of rated excitation being maintained, successful motor operation can be obtained with a variation in operating voltage of not more than ten percent above or below the rated nameplate value. With such a variation, however, operation will not necessarily be in accordance with the standards established for operation at the normal voltage for which the unit was designed.

Flywheel Effect

In the application of synchronous motors, it may be necessary to consider both the flywheel effect of the motor and of its load.

Flywheel effect is expressed as WK^2 and is equal to the weight of the revolving parts multiplied by the radius of gyration squared. Until recently this was expressed as WR^2. To avoid possible ambiguity in the use of "R" for both radius and radius of gyration, the "K" is now used for the latter, which is the effective radius of the weight of the flywheel for calculation purposes. Flywheel effect is ordinarily expressed as pounds-feet-squared.

Standard or normal pull-in torque, for a specific motor rating, will successfully synchronize or pull into step when connected to a load whose WK^2, exclusive of the motor, does not exceed an established standard. Thus on high inertia loads, it is important that sufficient motor pull-in torque be specified.

When the synchronous motor is connected to such a load as a reciprocating pump or compressor, the torque required varies through each revolution. This would result in objectionably large variations in motor armature currents unless properly compensated for. To do this, the motor manufacturer and compressor builder make sure that there is the proper amount of inertia or WK^2 in the rotating parts to limit the current pulsations to a satisfactory value, generally 66 percent of the rated full load current.

Motor Starting Current

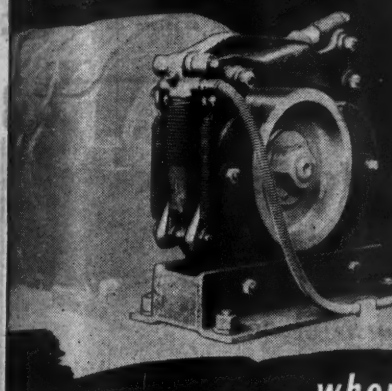
Starting current is defined as the kva. drawn by the motor when rated nameplate voltage is applied with the rotor locked.

Motor torques, speed, and power factor rating affect the starting kva. inrush. How this varies for different motor characteristics, and how it affects the selection of motor control, will be discussed in later articles.

In addition, more specific motor applications will be considered, bringing out points which will be of help in the proper selection of a synchronous motor for a specific drive.

I.A.E.I. PLAQUE (gold plated) commemorating the 50th Anniversary of the Underwriters' Laboratories, Inc., is presented to president A. R. Small (left) by James D. Lynett, president, I.A.E.I., at recent meeting of Western Section, I.A.E.I. at Indianapolis.

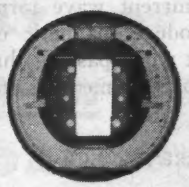
Use Wagner
INDUSTRIAL BRAKE CONTROLS



wherever industrial machinery must be stopped quickly, safely, and smoothly

A typical crane bridge-braking system as used on overhead cranes is illustrated. It consists of an external brake, which is actuated by a foot-operated master cylinder. The same system has been successfully applied to other machines, such as bending-rolls, scrap-balers, large wheel-balancers, and similar applications depending on foot pressure to decelerate the machine for either normal or emergency stops.

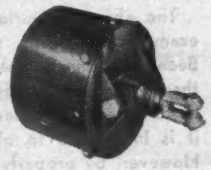
Wagner manufactures many other brake controls which may be applicable to your machines. These may be either air or hydraulically actuated. A general idea as to what these controls are may be obtained by referring to the illustrations shown on this page. However, types of applications for dependable brake control are numerous and very often difficult to determine. We suggest that you consult us and benefit by the recommendations of our trained and experienced brake engineers.



TYPICAL WAGNER LOCKHEED INTERNAL BRAKE

A typical Wagner Lockheed internal brake assembly. Available in various sizes for application to some types of industrial machinery. Wagner engineers will advise you whether this type of brake can be applied to your machinery.

AIR CYLINDER

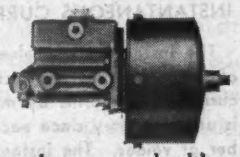


This Wagner air power-cylinder assembly converts the energy contained in compressed air into mechanical force, which (through linkage) expands the brake shoes in mechanical brake systems or actuates the hydraulic master-cylinder in air-hydraulic brake systems.

HYDRAULIC ACTUATOR CYLINDER

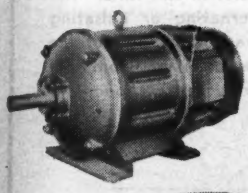
One of several types of hydraulic actuating-cylinders which transforms the hydraulic-fluid pressure into the mechanical force needed to apply the brake shoe against the brake wheel or drum.

POWER CLUSTER



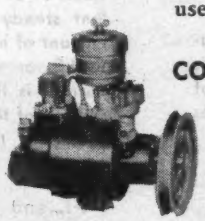
The Wagner Power Cluster simplifies the application of air power to hydraulic brake systems. It consists of a standard air power-cylinder assembled directly to a standard hydraulic master-cylinder. It produces desired hydraulic line-pressure by varying the air pressure without the use of levers or linkage.

MOTOR and BRAKE UNIT



Each unit is equipped with an internal expanding shoe-type brake that is applied by hydraulic pressure developed in a foot-operated master-cylinder.

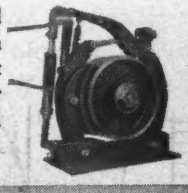
AIR COMPRESSOR



The function of this unit is to develop and maintain sufficient compressed air in air reservoir to operate air-brake system and other air-powered accessories.

TYPE HM BRAKE

Wagner Type HM Hydraulic Industrial Brake is intended for use on overhead cranes, whirler cranes, coke pushers, lorry cars, door machines, and transfer cars which require a parking brake when out of service or while performing their principal functions.



Foot-controlled master-cylinder

TELL US YOUR PROBLEMS

144-13

Wagner Electric Corporation

ESTABLISHED 1891

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ELECTRICAL AND AUTOMOTIVE PRODUCTS

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

D-3

Terms and Definitions Applicable to Electric Circuits and Electronic Tubes

3. CURRENT VALUES and MEASUREMENTS

For comparing the current wave forms or currents which subsequently produce magnetic or electrostatic fields and generate heat when passing through a resistance, the following comparison methods and terms should be considered:

A. SINE WAVE OF CURRENT

Most calculations or comparisons of current or wave form are based on a wave whose shape is sinusodial. When a closed coil rotates with a uniform velocity in a uniform magnetic field as illustrated by Fig. 1, the voltage generated and the resultant current have a sine wave form.

The above definition and the illustration are theoretical examples which do not consider the armature reaction. Because of mechanical limitations, it is impossible to meet the theoretical conditions. Also, as the magnetic lines of force enter and leave the iron surfaces perpendicularly, it is impossible to obtain the flux distribution as shown. However, by properly shaping the pole faces and properly distributing the conductors on the surface of the armature, the wave form can be made to closely approach that of a sine wave.

B. INSTANTANEOUS CURRENT VALUE—(i)

The instantaneous value of a current wave is the value of the current at any instant. The comparison of various current wave forms by means of the instantaneous values is unsatisfactory since each wave form has an infinite number of values. The instantaneous current values of various types of current flow are represented on Data Sheet D-2.

C. MAXIMUM CURRENT VALUE—(I_m)

The maximum value of an alternating current is the numerical value of the maximum instantaneous value. This value is quite important and is used to provide a basis of comparison for sine wave forms. All other current values are proportional to the maximum value.

D. AVERAGE CURRENT VALUE—(I_{av})

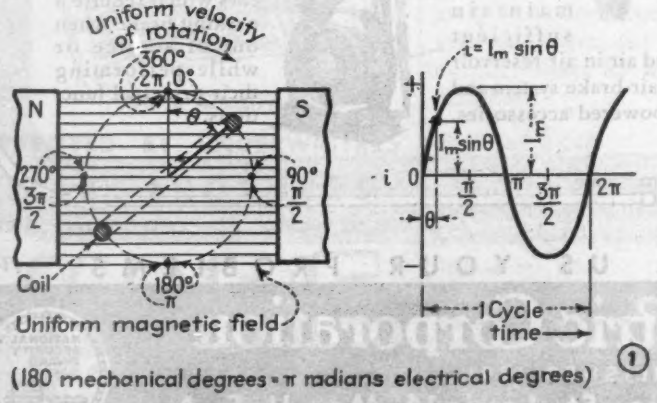
The average value of an alternating current for which the positive and negative half cycles are equal is defined as the numerical value of the average of the instantaneous values for a half cycle. The average over a complete cycle is zero as the positive values are cancelled by the negative values. Fig. 2 shows the graphical representation of the average value of the sine wave output of a half wave rectifier. The average current value is equal to the area of the curve divided by the length of its base. The equivalent rectangular current wave on the right hand side of Fig. 2 has an area equal to that of the sine wave, but has a constant instantaneous value which is known as the average value. A typical direct current instrument can read the average value and provide a basis for calculating magnetic field or effect which that current can produce.

E. EFFECTIVE OR ROOT-MEAN-SQUARE (R.M.S.) VALUE—(I)

Since a direct current instrument for measuring current is usually a type that will give the average value, it is not suitable for measuring alternating currents as the average value is zero. The torque developed on the rotating part of a direct current instrument is proportional to the current value and the direction of the flow. The net torque for 1 cycle of alternating current is zero as the torques produced by the positive and negative half cycles are equal and opposite in effect. The inertia of the rotating element of the instrument prevents it from indicating the instantaneous values.

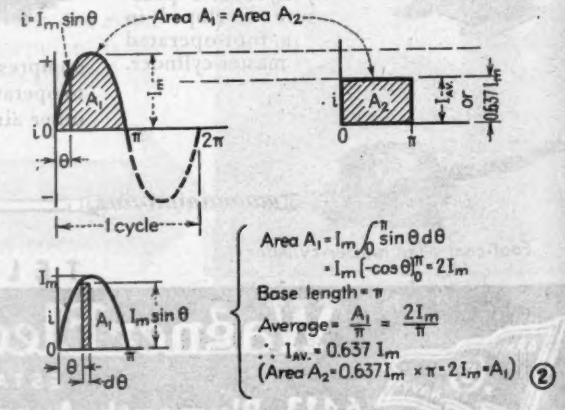
However, the heating effect of a current is proportional to its square and is therefore independent of the direction of flow. (A negative current value becomes positive when it is squared.) It is customary to define the effective value of an alternating or pulsating current as the equivalent steady direct current which will produce the same amount of heat energy in a given resistor in unit time. The R.M.S. or effective value of an alternating or pulsating current is the square root of the mean or average of the squares of the instantaneous current values for one complete cycle.

continued on page 92



(180 mechanical degrees = π radians electrical degrees)

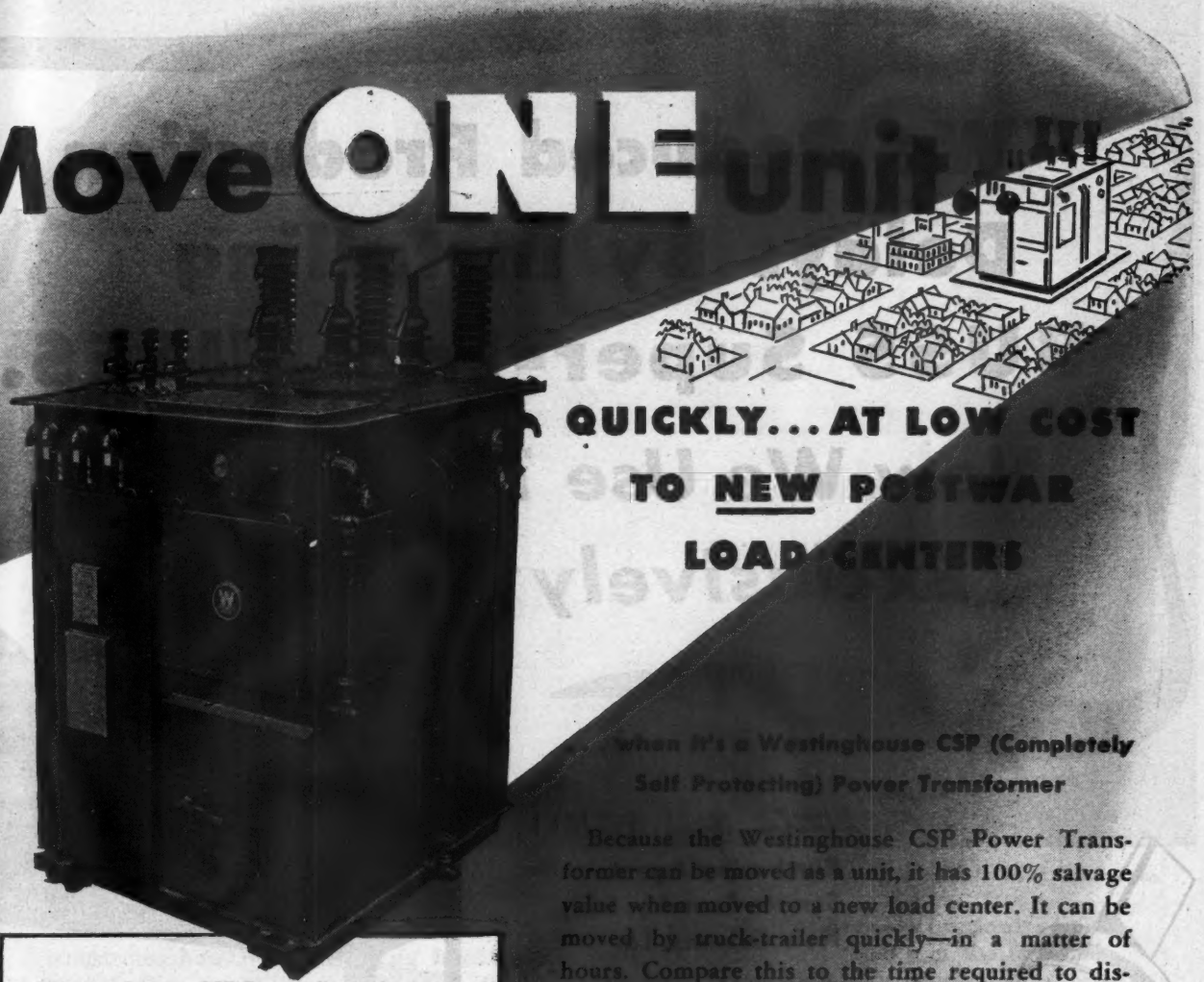
1—Generation of a sinusoidal wave.



2—Average value of a sine wave.

R. B. Immel, Westinghouse Elec. & Mfg. Co.

Move ONE unit ... III



QUICKLY... AT LOW COST TO NEW POSTWAR LOAD CENTERS

when it's a Westinghouse CSP (Completely Self Protecting) Power Transformer

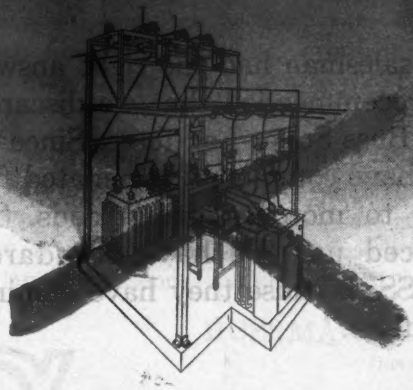
Because the Westinghouse CSP Power Transformer can be moved as a unit, it has 100% salvage value when moved to a new load center. It can be moved by truck-trailer quickly—in a matter of hours. Compare this to the time required to disassemble and move the conventional single-feeder substation. The CSP Power Transformer saves both material and man-hours . . . will cut considerably your postwar system reconversion cost.

While new postwar load centers may be unpredictable, it will pay to have substations which can be moved in to fill the gaps. The Westinghouse CSP Power Transformer performs all the functions of a single-feeder conventional substation. It is Completely Self Protecting (CSP) against lightning, short circuits, and dangerous overloads.

For complete information, call your Westinghouse office, or write Westinghouse Electric & Manufacturing Co., Dept. 7-N, East Pittsburgh, Pa. J-70429

Westinghouse CSP Power Transformers contain in ONE UNIT:

- transformer
- circuit breaker
- voltage regulator
- metering
- protection against —lightning
- protection against —overloads
- protection against —short circuits



NOT THIS . . . piece-by-piece time-consuming removal and reassembly of the 43 major components of a conventional substation.

WESTINGHOUSE

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

PACKAGED POWER

"We Reduced Production Delays By Installing BUSS Super-Lag FUSES. Now We Use Them Exclusively"

Reports **M. J. HYMEL,**
Purchasing Agent,
Service Foundry, Inc.,
New Orleans, La.

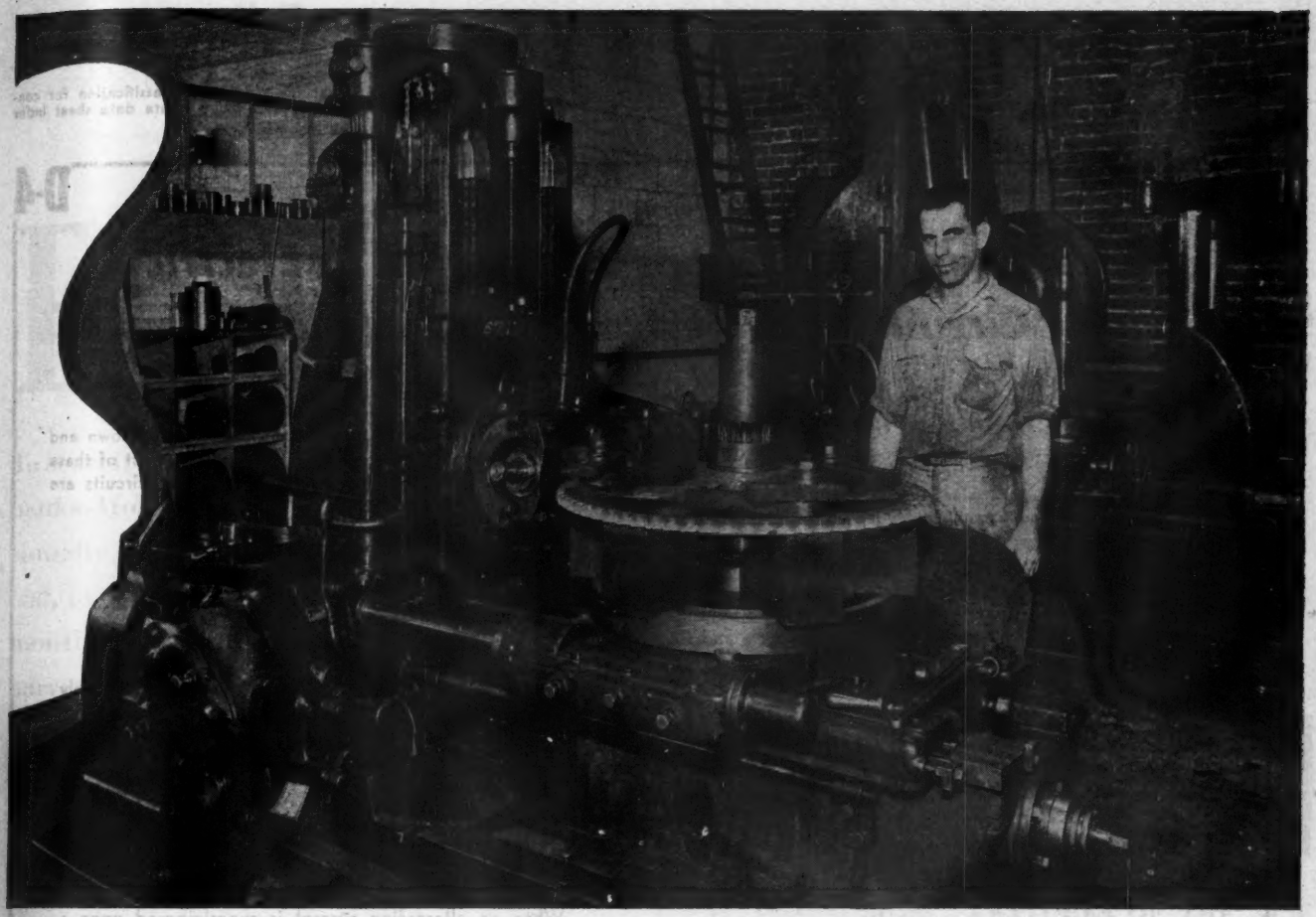
"About two years ago," says Mr. Hymel, "our electric motors were frequently shut down because fuses were blowing on motor starting loads. These shutdowns were costly—causing interruptions that cut production, disrupted scheduling, and made it difficult to meet delivery promises.

"A wholesaler's salesman had the right answer to our problem when he recommended that we discard our old fuses and use only Buss Super-Lag fuses. Since that time we have completely eliminated fuse blows due to motor starting loads. This convinced us. We have standardized on BUSS, because they have eliminated our troubles."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible. *and* **The SUPER-LAG** development in the FUSE-LINK completes the job.

★★★ **BUSS**



Gear Hobbing Machine in Service Foundry, Inc.

Here is another outstanding example that demonstrates how Buss Super-Lag fuses are helping to keep production running smoothly, how they reduce lost man-hours, and save trouble and grief for electricians and maintenance men.

If you have a problem similar to the one at Service Foundry, Inc., doesn't this example indicate how you can profit by the use of Buss Super-Lag fuses?

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant—by doing this today

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DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

D-4

Terms and Definitions Applicable to Electric Circuits and Electronic Tubes (con't)

E. EFFECTIVE OR ROOT = MEAN SQUARE (RMS) VALUE —(1) Continued from p. 88

Fig. 3 shows the graphical representation of the squaring of the instantaneous values and the equivalent rectangular area which is proportional to the square root of the average of the instantaneous current values squared. As the areas for each half cycle are the same, only one half cycle need be considered as the same result would be obtained by using the area for one complete cycle and the base line for one complete cycle.

F. FORM FACTOR

To provide a basis for the comparison of various wave shapes, the *form factor* of an alternating or pulsating current is defined as the ratio of its effective to its average current value.

$$\text{Form Factor} = \frac{I}{I_{av}}$$

G. CREST OR PEAK FACTOR

The *crest* or *peak factor* of a current wave is the ratio of its maximum to its effective value.

$$\text{Peak Factor} = \frac{I_m}{I}$$

The various current values in terms of the maximum value are tabulated in Data Sheet D-2 for resistive loads. These values serve as a basis of output comparison and as a mathematical means of comparing wave forms. Inductive or capacitive loads distort the wave forms shown and have values different from those given. The effect of these loads will be shown later when rectifier filter circuits are discussed and illustrated.

4. ELECTRO-MOTIVE FORCE VALUES and MEASUREMENTS

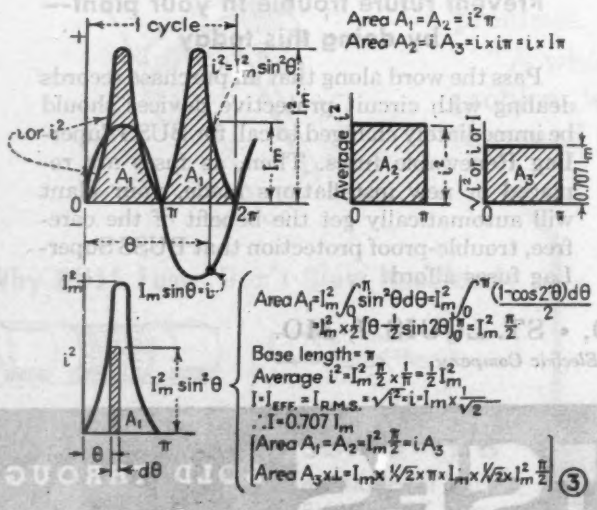
The definitions and current terms discussed above apply in general to the voltage wave forms which produce these current wave forms.

5. COMBINATION of DIRECT and ALTERNATING CURRENT WAVE FORMS

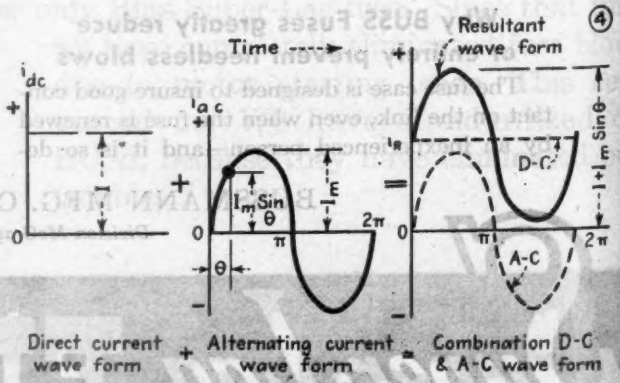
When an alternating current is superimposed upon a direct current, as in the plate circuit of an amplifier, the output wave form is a combination of the two and is shown by Fig. 4. The effective or average value can be found graphically or calculated by the separate wave form equations.

In such a circuit, carrying a combined direct and alternating current, the direct current value only may be measured with a permanent magnet type of direct current (averaging) instrument as it is unaffected by the alternating current. The alternating current value only may be read by means of an induction type of instrument which is unaffected by direct currents. A hot-wire meter or an instrument which measures the effective value of the combined wave forms will give a reading which is the square root of the sum of the squares of the readings of the other two instruments.

The combined form may be separated into the original components by means of a filtering circuit which may pass only alternating currents.


1 cycle
Area $A_1 = A_2 = i^2\pi$
Area $A_2 = i\,A_3 = i \times i\pi = i \times I\pi$
$i^2 = i_m^2 \sin^2\theta$
Average i^2
$I_m \sin\theta = i$
Area $A_1 = I_m^2 \int_0^\pi \sin^2\theta\, d\theta = I_m^2 \int_0^\pi \frac{(1-\cos 2\theta)d\theta}{2}$
$= I_m^2 \times \frac{1}{2}[\theta - \frac{1}{2}\sin 2\theta]_0^\pi = I_m^2 \frac{\pi}{2}$
Base length $= \pi$
Average $i^2 = I_m^2 \frac{\pi}{2} \times \frac{1}{\pi} = \frac{1}{2} I_m^2$
$I = I_{Eff.} = I_{R.M.S.} = \sqrt{i^2} = I_m \times \frac{1}{\sqrt{2}}$
$\therefore I = 0.707\, I_m$
Area $A_1 = A_2 = I_m^2 \frac{\pi}{2} = i A_3$
Area $A_3 \times L = I_m \times 1/\sqrt{2} \times \pi \times I_m \times 1/\sqrt{2} \times I_m^2 \frac{\pi}{2}$
③

3—Effective value of a sine wave.



4—Combination D-C and A-C wave form.

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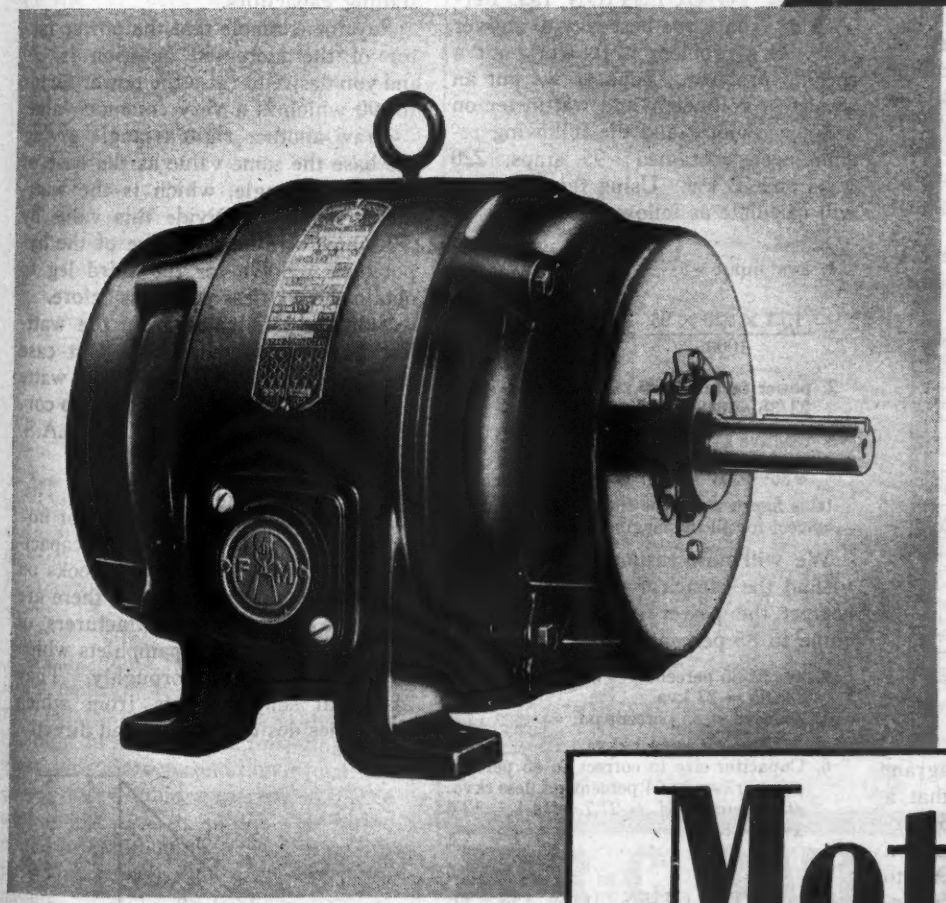

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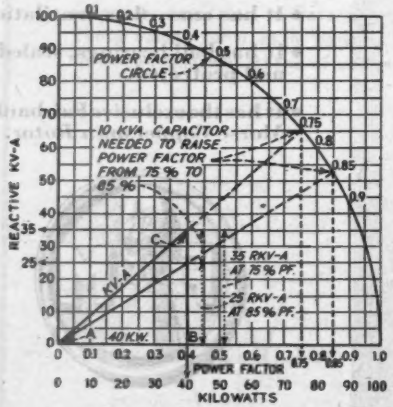
READER'S QUIZ

CALCULATING CAPACITOR RATINGS

QUESTION 153. *I have tried to find some information from various places whereby one can figure what size capacitors to put on an a.c. line to help the power factor. When one has a certain size of induction motor load and knowing or suspecting the power factor to be low how do you determine what size capacitor to install?—C. A. B.*

A. TO QUESTION 153. I believe all manufacturers of capacitors for power factor correction have material on how to apply capacitors to distribution feeders. However, most problems in power factor correction can be solved by use of a power-factor circle diagram. The graph is constructed by describing an arc of a circle with A as the center (see diagram) and with a radius of 100 units.


POWER FACTOR CIRCLE
10 KVA. CAPACITOR NEEDED TO RAISE POWER FACTOR FROM 75 % TO 85 %
35 RKV-A AT 75 % PF.
25 RKV-A AT 85 % PF.
40 KW.
REACTIVE KV-A
POWER FACTOR
KILOWATTS

As an example refer to the diagram above. It has been determined that a 40 kw. load is operating at a 75 percent power factor. First draw a straight line from the center (A) to the .75 mark on the power factor circle. Then project a vertical line up from the 40 kw. mark on the horizontal axis. The intersection of the two lines (point C) determines the amount of lagging rkva supplied by the load. This is found by projecting point C horizontally to the vertical rkva axis and is seen to be 35 rkva in this case. Now assume that the load is to remain the same 40 kw. but a power-factor of 85 percent is desired. Draw another line from center A to the .85 mark on the power factor circle. The inter-section of this new line with the 40 kw. load line shows that to operate at 85 percent power factor only 25 rkva may be supplied to the line. This means that 10 lagging rkva must be neutralized by 10 leading rkva. Thus a 10 kva capacitor will be required.—V. I. M.

A. TO QUESTION 153. Perhaps the best way to answer C. A. B.'s problem is to work out a specific problem. Suppose we put an ammeter, voltmeter, and wattmeter on a 3-phase motor and the following results were obtained: 95 amps, 220 volts and 23 kw. Using this data, we will calculate as follows:

1. kva. input $= \frac{1.73 \times E \times I}{1000} =$

$$\frac{1.73 \times 220 \times 95}{1000} = 36 \text{ kva. (approx.)}$$

2. power factor = kw./kva. = 23/36 = 64%
3. reactive kva. $= \sqrt{(\text{kva.})^2 - (\text{kw.})^2} =$

$\sqrt{36^2 - 23^2} = 27.7$ rkva.

(this figure would be the capacitor size to correct for all the lagging reactive kva.)

We will now assume that we wish to find the capacitor size necessary to correct the power factor of this machine to 85 percent.

4. kva at 85 percent = kw./.85 = 23/.85 = 27 kva.
5. reactive at 85 percent p.f. = $\sqrt{27^2 - 23^2} = 14.1$ rkva.
6. Capacitor size to correct to 85 percent p.f. = rkva. at 64 percent p.f. less rkva. at 85 percent p.f. = 27.7 − 14.1 = 13.6 kva. — R.E.

A. TO QUESTION 153. To determine the power factor of the motor install a wattmeter, (a polyphase wattmeter if 3 ph.), a voltmeter and an ammeter in the supply lines to the motor.

If it is a three phase motor, multiply the volts read by the amperes and then by the square root of three, which is 1.73. This will give input volt-amperes. The wattmeter will indicate the true power in watts.

The wattmeter reading divided by the computed volt-ampere figure is your power factor for that motor.

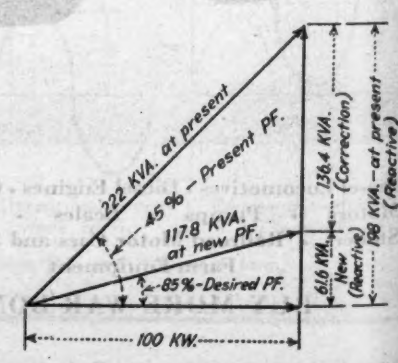
Now draw a right triangle giving the hypotenuse the value of the volt-amperes and the base of the triangle the value of the wattmeter reading. Solve for the third leg or altitude which will be the wattless power causing the particular power factor. This wattless value can be decreased by installing capacitors.

Say for example that the power factor of the motor in question is .70 and you desire to raise the power factor to .90 which is a very common value.

Draw another right triangle giving the base the same value as the base of the first triangle, which is the wattmeter reading. Divide this value by .90 which will be the value of the hypotenuse. Solve for the third leg to obtain the wattless power as before.

Subtract this value from the wattless power obtained in the first case and you will have the value in watts of the capacitors to be installed to correct your power factor to .90—B.A.S.

A. TO QUESTION 153. The problem of power factor improvement, and application of capacitors, is covered in most textbooks on electrical engineering. Also, there are available from the manufacturers of capacitors instruction pamphlets which cover the question thoroughly. They also will supply charts from which the values desired can be read directly.


222 KVA. at present
45 % – Present PF.
117.8 KVA. at new PF.
85 %-Desired PF.
136.4 KVA. (Correction)
61.6 KVA. New (Reactive)
198 KVA. – at present (Reactive)
100 KW.

The method I use is a simple one, which is illustrated below. Let's assume a motor load of 100 kw. at 45 percent p.f. and proceed as follows: All that is necessary for a simple solution is to draw a right triangle and proceed as if solving a problem in trigonometry.

Pres. load = 100 kw. at 45 percent p.f. (assumption)
Desired p.f. = 85 percent.

$$\text{Pres. kva.} = \frac{100}{.45} = 222 \text{ kva.}$$

$$\text{Pres. reactive kva.} = \sqrt{222^2 - 100^2} = 198 \text{ kva.}$$

$$\text{Kva. at desired p.f.} = \frac{100}{.85} = 117.8 \text{ kva.}$$

Reactive kva. at desired p.f. = $\sqrt{117.8^2 - 100^2} = 61.6$ kva.
Corrective effect needed = (198 − 61.6) = 136.4 kva.

— R.L.M.

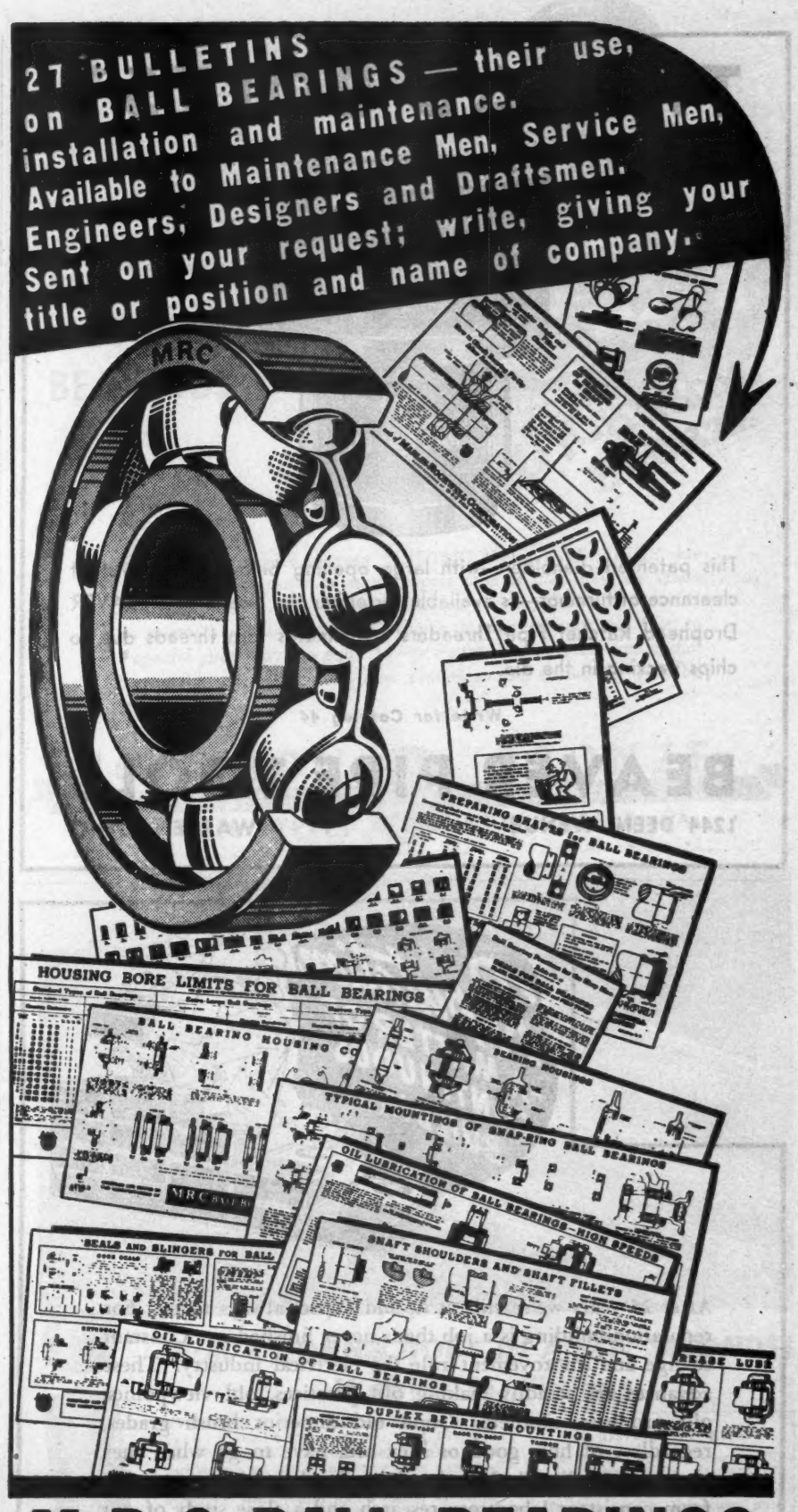
WIRING THREE-WAY SWITCHES

QUESTION 154. I have been wiring homes and farm buildings for 23 years, but I have never run across one like this. A farmer here has a yard light controlled by two 3-way switches, one in the kitchen, one in the garage. With the kitchen light fuse in place, both 3-way switches operate normally, and light the yard lamp. But upon removing the kitchen light fuse, the yard lamp goes on, and neither 3-way switch will operate until the kitchen light fuse is replaced. The current is 110 volts, 60 cycles. There is also a wall switch controlled lamp in the garage. What's wrong?—R. J. W.

A. TO QUESTION 154. I suggest that R. J. W. separate the 3-way circuit from other circuits and check it with an approved diagram of a light operated by two 3-way switches.—B. C. M.

A. To QUESTION 154. No doubt the yard light hookup is one contrary to the Code—with current fed from both switches, and with the light in series. The following diagram illustrates a condition which can cause the trouble experienced. We assume the fuse is in the "hot" side of the line, although if there is one in the grounded wire too, there are more possible sources of trouble—such as feed-back from the ground at another building, a shorted pump motor, etc.

Only on position (1) of the garage yard light switch, would the yard light refuse to burn with the kitchen fuse out. That is because there is no source of live current. With garage yard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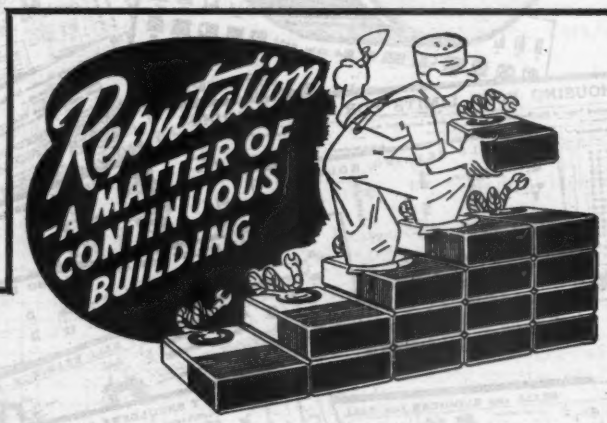

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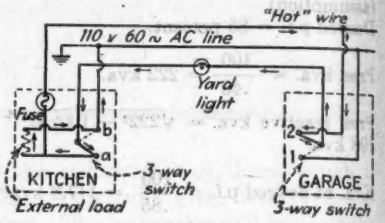
light switch in position (2) the yard light will light up only with kitchen yard light switch in position (b), except if there are no other loads—such as a refrigerator, pump, wash machine, flat iron, large radio, or a light load of 200 watts or more, connected across the wiring in the house. If there are, the light will also burn with switch in



position (a)—the brilliance depending on the wattage ratio of the yard light lamp compared with the rating of the equipment in series with it. Follow the arrows, and you will see that the lamp will light with the fuse out—and with the switches in position (2) and (a), if there is an external load turned on.—F. J. M.

CAPACITOR SIZES FOR SMALL MOTORS

QUESTION 155. In the small capacitor type motors what is the main function of the capacitor and how is the capacitor size determined?—W.E.J.

ANSWER 155. The main function of a capacitor-start motor is to produce a higher starting torque which is about twice that of a split-phase motor using the inductive reactance starting principle.

The size of the capacitor is determined by the design of the motor and is calculated so as to give the starting winding a leading current, which in relation to the lagging current in the running winding gives the proper phase displacement which is greater than in the ordinary split-phase motor. This increased phase displacement is the reason for the improved starting torque of the capacitor-start motor.—S. S. P.

ANSWER 155. There are so many different kinds and varieties of capacitor motors that the simple term capacitor motor ought never be used by itself without additional qualification. It is assumed though that the writer refers to the capacitor-start variety of capacitor motor.

A capacitor-start is a form of split-phase motor having a capacitor connected in series with the auxiliary winding. The auxiliary switch is opened when the motor has reached a pre-determined speed. This speed is approximately 75 percent to 80 percent of synchronous speed.

The function of the capacitor may be to reduce the locked rotor current, and increase the starting torque, or to reduce the locked rotor current only. The winding is designed and capacitor specified to perform a duty for a specific application which may be small refrigerator motors and motors for similar applications.

In replacing a capacitor, select one similar to or exactly like the one replaced; the values are usually on the case of the capacitor. In the absence of markings, the size can be closely approximated from the following formula for 60 cycle motors:

$$\text{microfarads} = \frac{2650 \times \text{amperes}}{\text{applied voltage}}$$

and for 25 cycle motors:

$$\text{microfarads} = \frac{6350 \times \text{amperes}}{\text{applied voltage}}$$

Example: Select a capacitor to replace one on a single phase capacitor motor 115 volts, 3.8 amperes, ¼ H.P., 1725 RPM, 60 cycle. There are no markings on the capacitor or case:

$$\frac{2650 \times 3.8}{115} = 88 \text{ mfd.}$$

The normal rating of capacitor required is 88 mfd.

From a table of sizes for 115 volts, 60 cycle, select one ranging from 86 to 96, and operation will be satisfactory. It is not a good practice to *reduce* the ratings from normal too much, since the increase in voltage will eventually puncture the insulation. A capacitor that is too large will affect the pull-in torque.—M.G.L.

ANSWER 155. The capacitor motor has two windings in which the currents must be displaced in time phase in order to obtain the rotating field necessary to develop starting torque. Since both windings are connected to the same voltage, a capacitor is placed in series with one winding, which causes the current in this winding to lead the voltage. The current in the other winding lags behind the voltage, thus making the motor operate similar to a two-phase motor.—C.J.H.

ANSWER 155. If a single phase motor were built with just one winding it would not start automatically, but would run in either direction should the shaft be given a quick turn manually.

The same would be true if two identical windings were installed in the motor connected in parallel.

If a capacitor is installed in series with one of the two windings in parallel, its effect would be to create a force 90 electrical degrees away from the force created by the other winding. In other words, a revolving field is produced which causes the motor to start automatically. By reversing one

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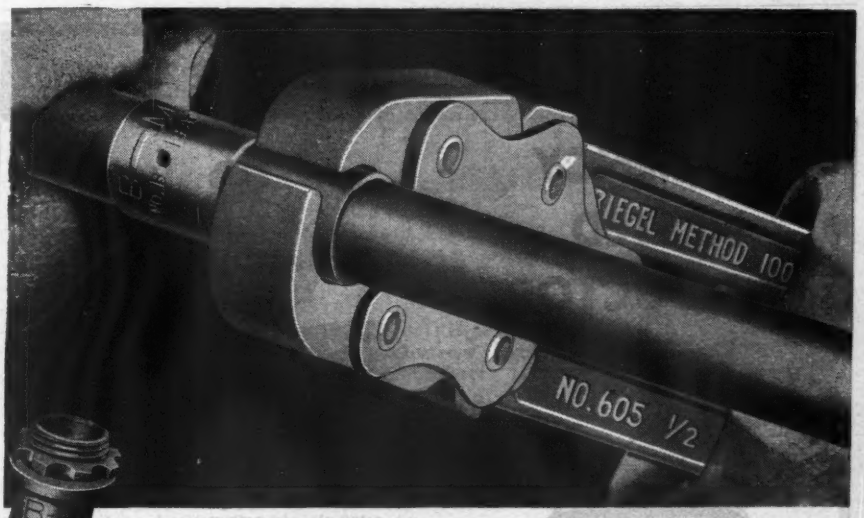

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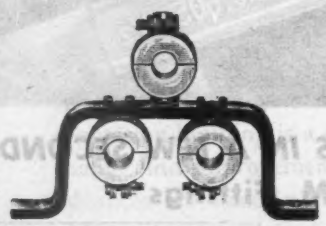

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of the windings the motor will run in the opposite direction.

In practice, however, the two windings mentioned are not identical but the effect of the capacitor in the circuit is the same as described.

Usually, the capacitor size is chosen that will cause the motor to produce the maximum torque.

If you insert a capacitor in the starting circuit and the capacitor has a low mfd. capacity, the motor will start if not loaded too heavily even though the starting torque is low.

If you continue to insert capacitors, each successive capacitor having a greater mfd. capacity, and take readings of the torque produced by the motor for each capacitor, you will find that the torque values will increase very rapidly up to a certain value of capacitor and then as greater values are installed the torque will decrease but not as rapidly as it increased for the same capacity difference.

A capacitor is usually chosen that has a little greater capacity than the one used when the peak value of torque was obtained. The reason for this is that climatic conditions affect capacitors and their effective value is not always the same. Therefore, if a capacitor is selected that is of a little higher value than the one that produced the peak value of the torque, it is operating at a point where a little change in value does not appreciably affect the torque.—B.A.S.

ANSWER 155. The main purpose of the capacitor on the capacitor motor is to increase the electrical angle between the main winding and the auxiliary winding or starting winding; thereby giving increased starting torque and incidently decreasing the starting current over the reactance type split-phase motor. With the starting winding current displaced 90 electrical degrees from the main winding current by the capacitor connected in series with the starting winding, the starting affect of the capacitor motor is similar to that of a two-phase motor. The size of the capacitor is determined by the starting torque required.—R.E.

ANSWER 155. Primary function of the capacitor in the small capacitor type motor is to provide better starting conditions. In some motors the capacitor remains in the circuit and improves the power-factor of the motor. In the other capacitor start motors, it is cut out by a centrifugal switch and so functions only during the starting period.

There are two windings in such a motor, the main one connected directly to the source of power and the auxiliary winding connected in series with

a capacitor. The windings are spaced about 90° apart on the rotor and the effect of the capacitor is to make the auxiliary current lead the main current and so produce magnetic field conditions similar to those in a two-phase motor. This results in a good starting torque and lower starting current as well as the higher power factor.

The proper capacitor size depends upon the design of the motor. It is best to use the size provided by the manufacturer. Too small a capacitor may result in too high a voltage across the capacitor; too large a capacitor will not cause any danger, but will give a smaller pull in torque. In general, the size should be such as to draw an auxiliary current about 45 percent of the locked rotor main current.

For a small motor, 1/6 to 1/3 HP., 110 volt, the capacitor should be from 100 to 150 microfarads.—J.E.W.

ANSWER 155. The main function of the capacitor is to make the current in the auxiliary winding lead the line voltage by about 45 degrees. The current in the main winding usually lags behind the voltage about 45 degrees. The total phase displacement of approximately 90 degrees of the current in the main winding behind the current in the auxiliary winding causes the two windings to have operating characteristics similar to those of a two-phase motor and produces a rotating magnetic field. The capacitor also causes a lower starting current and higher torque per ampere of starting current. If the capacitor is too small, the motor will not develop satisfactory starting torque. Too large a capacitor in a capacitor-start motor will decrease the starting torque and increase the locked current.

The proper value of capacitor for a single capacitor start and run motor may be determined by measuring the watts input to the main winding and selecting a capacitor for the auxiliary winding which will indicate a watts input from 1/2 to 2/3 as much as the input to the main winding.—R.G.C.

Can you ANSWER these QUESTIONS

QUESTION B7— Recently we rewound a 230 volt d.c. armature of a 25 hp. series wound hoist motor used on an overhead crane. When we placed it back in service it ran approximately 1900 rpm under no load. It should not have run over 1000 rpm. at no load and 510 rpm. under full load. It sparked excessively and ran very hot, finally throwing off the band wires which again made it necessary to take it out of service.

The armature has 40 slots, 79 bars and is wave wound. The coil pitch is 1 to 10

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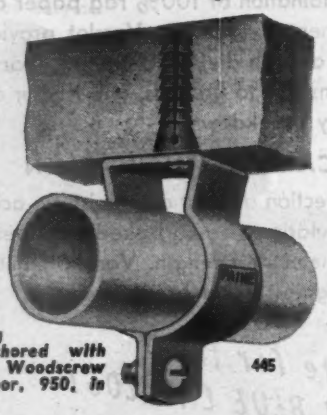

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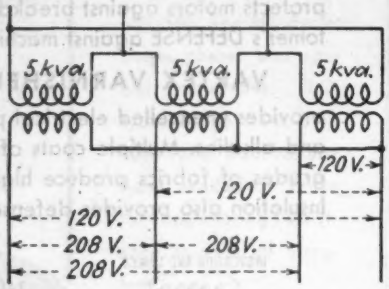
and the data as recorded shows the commutator pitch to be 1 to 42, which is the way it is connected. There are two turns per coil, wound two in hand, using No. 11 magnet wire. Evidently the trouble is in the armature for we replaced it with a spare and it ran all right, indicating that the fields are okay. Can anyone give me an answer as to what the trouble is?—F.F.

QUESTION C7—I would like to run a branch circuit 300 feet to a five hp. motor rated three phase, 208 volts, 60 cycle. What size wire would be required and what is the formula for potential drop?



With reference to the accompanying diagram, what would be the current in each of the four wires, and how much line current capacity remains for a 120 volt lighting load?—W.F.M.

QUESTION D7—We have quite a bit of high voltage parkway cable, lead covered with steel armor, and directly buried in the earth an average of four feet down. Although we have had no failures to date, I am wondering if someone can tell me a method by which a fault may be located with some instrument used above the surface. This would save quite a bit of digging if something like this can be done.—L.R.B.

QUESTION E7— In calculating the size wire to be used for an 800 foot three conductor run to a 150 hp., 3 phase, 550 volt motor, I used the standard formula:

$$CM. = \frac{10.8 \times 2 \times 800 \times 180}{16.5}$$

$$= 188500 \text{ cir mils}$$

The motor has a full load rating of 144 amps. and the 180 in the formula accounts for the Code requirement of 125 percent F.L. amperes. Allowing for a 3 percent voltage drop gives 16.5 volts over the 800 feet.

Now, according to the 1937 Code, 200,000 CM. conductors (which take into consideration no voltage drop) are required; yet the formula permits me to use smaller wire and in addition allows for a three percent drop.

(1) Why is this, and is my formula correct?

(2) If two conductors are paralleled per leg, how is the size of each computed?

(3) How would costs compare in running feeder underground as against an open run on a pole line already in use?—F.R.B.

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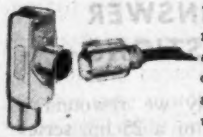

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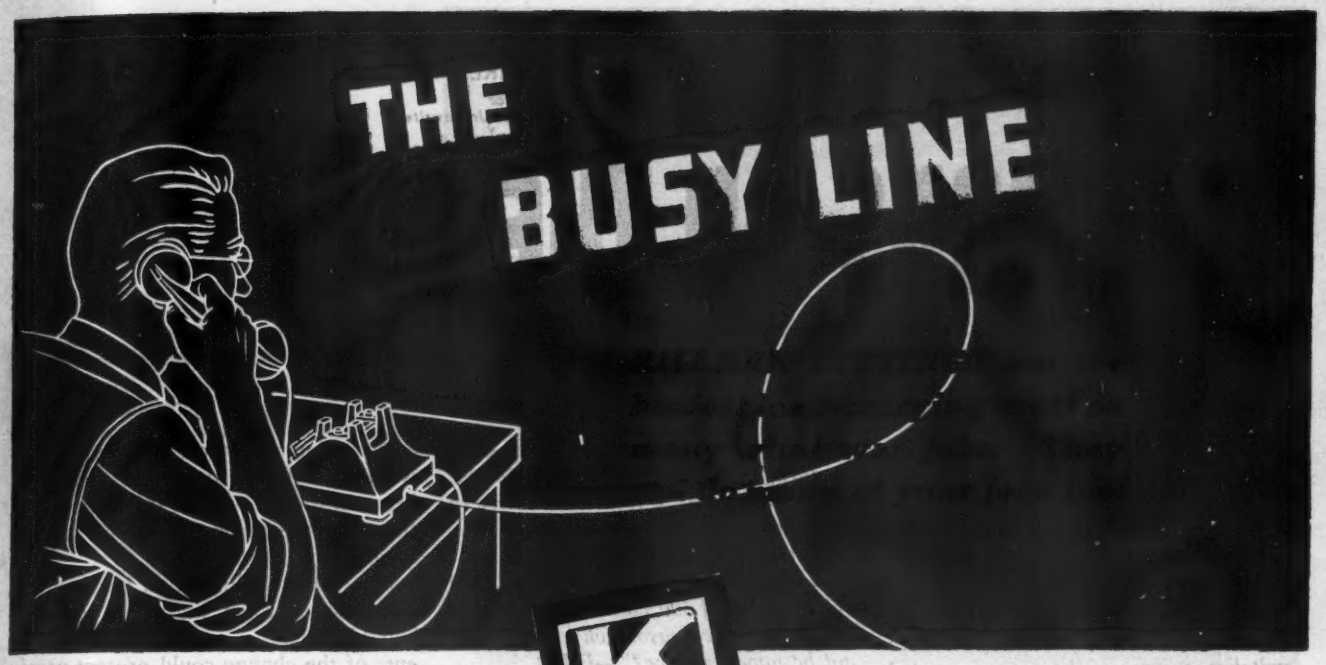

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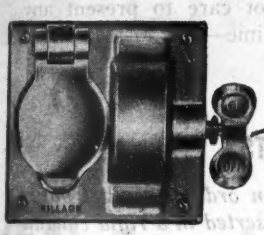

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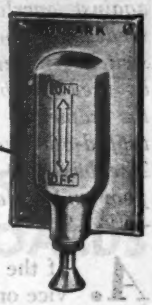

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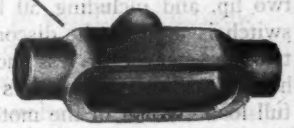

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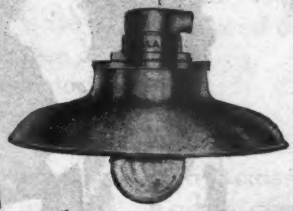

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Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector, New York Board of Fire Underwriters, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

QUESTIONS ON THE CODE

RATING OF BUSWAY TAPOFF SWITCHES

Q. *"Several of the branch circuits in our plant, which are tapped from the main bus duct through fused disconnect switches, were not approved, on the grounds that the switches were not horsepower rated and should not be opened under load. Each motor is individually protected against overload and it was not intended to open these branch circuit switches under load, but they were to be used for branch circuit protection the same as fuses would be where tapped-off circuits consisted of cable. The bus duct is eleven feet from the floor and a plant electrician in charge. —W.J.S.*

A. If the switch in the tap-off device on the busway is used as a motor disconnecting means, it must be rated in horsepower for motors over two hp. and including 50 hp. If this switch is used as the disconnect for a two horsepower or less motor, it can have a rating in amperes twice the full load current of the motor. Also if there is another switch ahead of the motor controller, then this tap-off switch becomes merely a feeder switch and it can have only an ampere rating. Again if the motor controller complies with 4407 so that it can serve as both controller and disconnecting means, this tap-off switch can have merely an ampere rating.—F.N.M.S.

METER SEQUENCE ABOVE 300 VOLTS

Q. *"Please refer to Article 230, Section 2375, sub-paragraph e of the 1940 issue of the National Electrical Code. Is it the intention of this paragraph to prohibit the use of service meters ahead of the disconnecting means and the overcurrent device when the supply is in excess of 300 volts?*

Sections 2352—'Control' excepts meters as to the location of the disconnecting means. Section 2375—sub-paragraph b also excepts potential coils of meters as to location relative to overcurrent device.

Is it possible that Section 2375, sub-paragraph 'e' should have read 600 volts instead of 300 volts? If not, would you advise the reason why this would not be good practice?"—F.J.D.

A. The Code in rule 2375e permits the meter to be placed on the supply side of the service equipment on alternating current services where the voltage between conductors does not exceed 300 volts. This means that for direct current services of any voltage and on alternating current services where the voltage between conductors is more than 300 volts, the meter or metering equipment must be placed on the load side of the overcurrent device (fuse or circuit breaker).

While according to this sub-paragraph 2375e, the meter has to be on the load side of the overcurrent advice (where the voltage is over 300 volts), the meter could be on the supply side of the service switch. However, as the service equipment is generally one enclosed unit (switch and cutout), it would be difficult to connect the meter between the cutout and the switch and therefore the meter should be on the load side.

The 300 volt limitation has been in the Code over ten years but probably could be changed provided the proponents of the change could present proof that there would be no increase in property or personal hazards. This writer does not care to present any views at this time—F.N.M.S.

***REINSPECTION PROGRAMS** for the postwar era is the topic of this post-session huddle between V. C. Moulton (left), chairman, I.A.E.I. committee on postwar reinspections and Thomas P. Branch, head of the Farm Wiring Installation and Inspection Section, R.E.A., St. Louis, Mo. at recent Indianapolis inspectors meeting*

BOX SUPPORTS

Q. *"When ordinary outlet boxes are inserted in a rigid conduit run, is it necessary to provide individual support for each box or may they be supported by the conduit?"*—M.L.

A. The N. E. Code under Section 3709 states that boxes and fittings, not over 100 cubic inches in size, which are attached to firmly secured exposed raceway by threading or other connection designed for the purpose are considered to be securely fastened in place. The wording "or other connection designed for the purpose" does not mean that lock nut and bushing connections are suitable for this purpose. Where lock nut and bushings are used the box must be provided with its own means of support.—G.R.

WATER PIPE ELECTRODE

Q. *"May a ¾-inch galvanized water pipe electrode be made up of short sections of pipe joined by ordinary galvanized pipe couplings?"* —E. G.

A. Under Section 2583-d of the N. E. Code is found the following statement: "Pipes or rods when less than standard commercial length shall preferably be of one piece." However, a better answer to your question is found under Section 2584 which

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reads as follows: "Buried or driven electrodes shall, if practicable, have a resistance to the ground not to exceed 25 ohms. If the resistance is not as low as 25 ohms, two or more electrodes connected in parallel shall be used." While it is possible that this latter requirement might be met by the coupled electrode shortly after it had been driven, corrosion would rapidly attack the threaded portions where the protective galvanizing had been removed and within a very short time the resistance within the couplings would be extremely high and in reality the electrode would be no longer than the first section of pipe to which the grounding conductor is attached.—G.R.

APPLIANCE CIRCUIT

Q. *"Does the Code require that the No. 12 appliance circuit be protected by a 20 ampere rated overcurrent device?"*—A. N.

A. No, the National Electrical Code simply requires that the conductors used for the appliance circuit supplying outlets in the kitchen, laundry, pantry, dining room and breakfast room be not smaller than No. 12. Usually it is advantageous to provide 20 ampere rated overcurrent protection.—G. R.

MAGNETIC SWITCH FOR MOTOR DISCONNECTION

Q. *"Would a magnetic switch rated in horsepower, used for the control of a motor satisfy code requirements under Article 4402?"*—W.J.S.

A. In general a magnetic controller for a motor requires a disconnecting means ahead of it so that the circuit can be opened in order to service or work on the controller. However, if the magnetic switch is also capable of being operated directly by the application of the hand to a lever or handle, it would meet the requirements of 4407a. It would of course, have to have a direct linkage between the handle or lever and the contacting parts and would also have to open all ungrounded conductors to the motor.

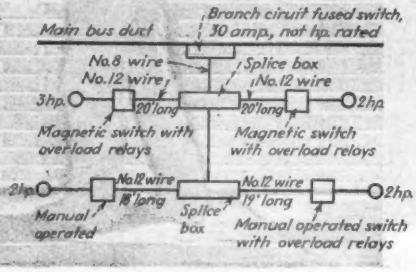
Possibly our inquirer desired to know if the disconnecting means ahead of a controller could be a magnetic switch; that is, another magnetic switch ahead of a magnetic controller.

While such an arrangement would appear to be uneconomical and to serve no useful purpose, the answer would be yes, provided the disconnecting switch opened all ungrounded conductors of the circuit and otherwise met the requirements of Sections 4402, 4403, 4404, 4405, 4406 and 4409. In this case it would not have to satisfy Section 4407 as there would be a separate disconnect and a separate controller.—F.N.M.S.

RATING OF MOTOR DISCONNECT

Q. *"Is it required to have horsepower rated disconnecting switches for all motors ahead of magnetic switches?*

"The following one line sketch is



typical of the installation and I would greatly appreciate your opinion.

"Branch circuit fuses and motor overload relay ratings were satisfactory."—W.J.S.

A. As indicated in a preceding answer the disconnecting means for motors of horsepowers ranging from over two up to and including 50, have to be rated in horsepower while switches for motors of two horsepower and less, and of over 50 horsepower, may be rated in amperes. These requirements would hold whether the controllers are magnetically operated or not.

In the layout indicated by the above diagram, the 30 amp. branch circuit fused switch not horse power rated, would not satisfy the Code requirements for the disconnect switch for several reasons:

First—The 3 hp. motor with a magnetic controller alone requires a horse power rated disconnect ahead of the controller.

Second—Assuming 3 phase 220 volt motors in the same room, the three 2 hp. motors alone would require more than a 30 amp. switch as their disconnecting means without considering the 3 hp. motor.

Third—The branch circuit switch is not within reach.

To correct the above layout, one of the following methods could be used:

1—If the upper "splice box" is within reach and is in the same room, with all of the motors, a 10 hp. manually operable switch could be used; or

2—Under the same conditions of accessibility a 3 hp. switch to disconnect the 3 hp. motor and a 60 amp. switch to serve as disconnect switch for the rest of the motors, could be used, or

3—If the "manual operated" controllers be operated "by application of the hand to a handle or lever" and thus do not require a disconnect ahead of them, then a 3 hp. switch can disconnect the 2 hp. motor with its magnetic controller, with no separate disconnect for the other 2 hp. motors with their manual controllers.—F.N.M.S.

SOLDERED JOINTS

Q. *"A recessed lighting installation was recently turned down by the inspector because of the use of soldered joints in the fixture box. Does the Code prohibit the use of soldered joints or is that some ruling of the city inspector?"*—A.N.S.

A. The National Electrical Code specifically prohibits the use of solder in the construction of recessed or flush type fixtures under Section 94102-d which states "No solder shall be used in the construction of the fixture box."—G.R.

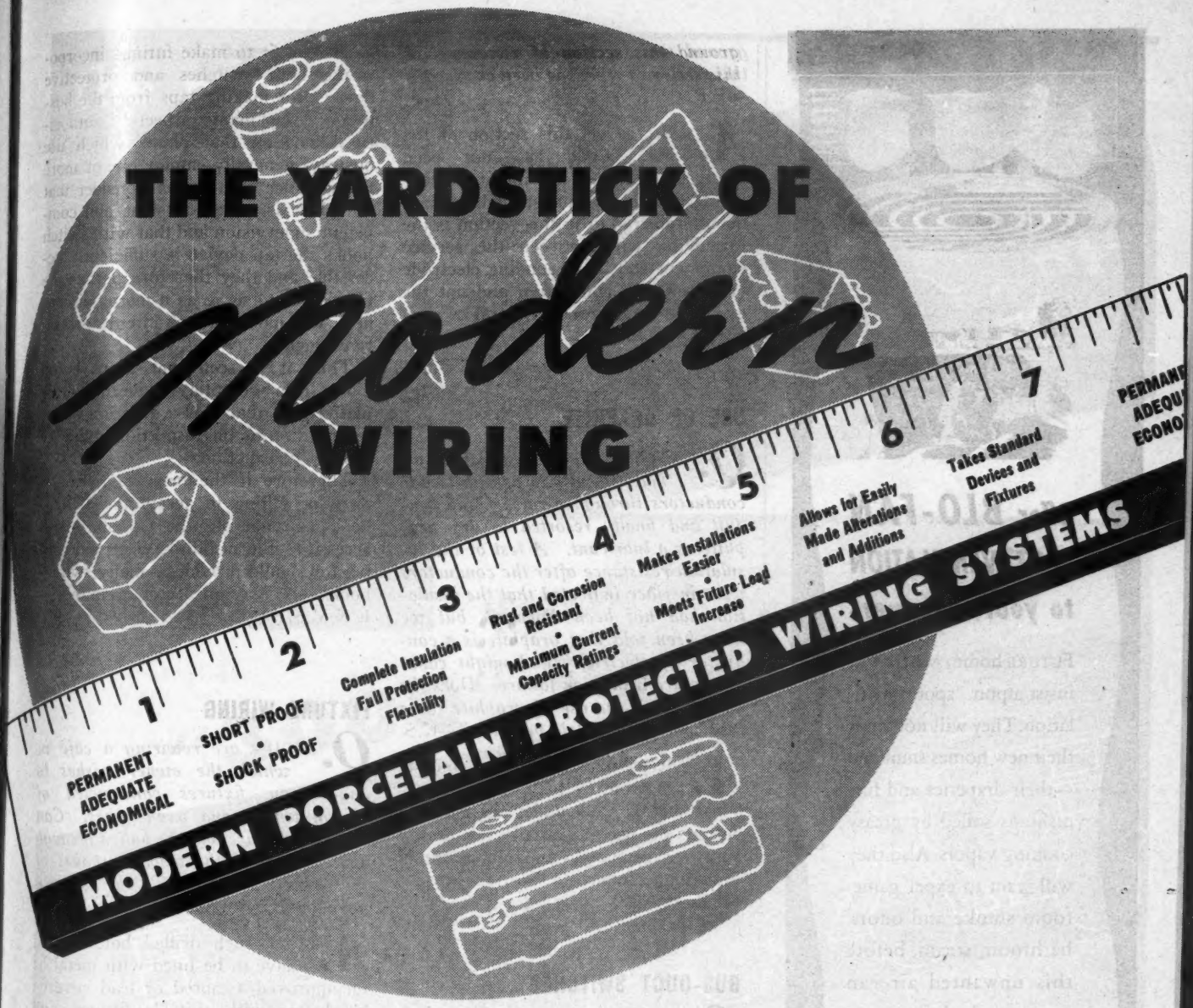
OUTLET BOX IN CLASS 2 LOCATION

Q. *"Can an ordinary outlet box be used in a Class 2 location?"*—J.D.

A. Ordinary outlet boxes may be used in Class 2, Group G locations but not in Class 2, Group E atmospheres. In other words, ordinary outlet boxes which contain only properly made splices and insulated conductors may be used in dusty locations providing the dust is non-conductive. Where metal or other conductive dusts are present, all boxes and other fittings must be of the dust-tight Class 2, Group E type.—G.R.

GROUNDING OF RACEWAY

Q. *"Under Section 2553 of the Code, permission is granted to use the system grounding conductor for the grounding of raceway or equipment. A short time ago I grounded a short section of raceway used in connection with an otherwise non-metallic job to the grounded conductor and the inspector refuses to accept it and states that I must run a separate conductor from the service equipment just to*



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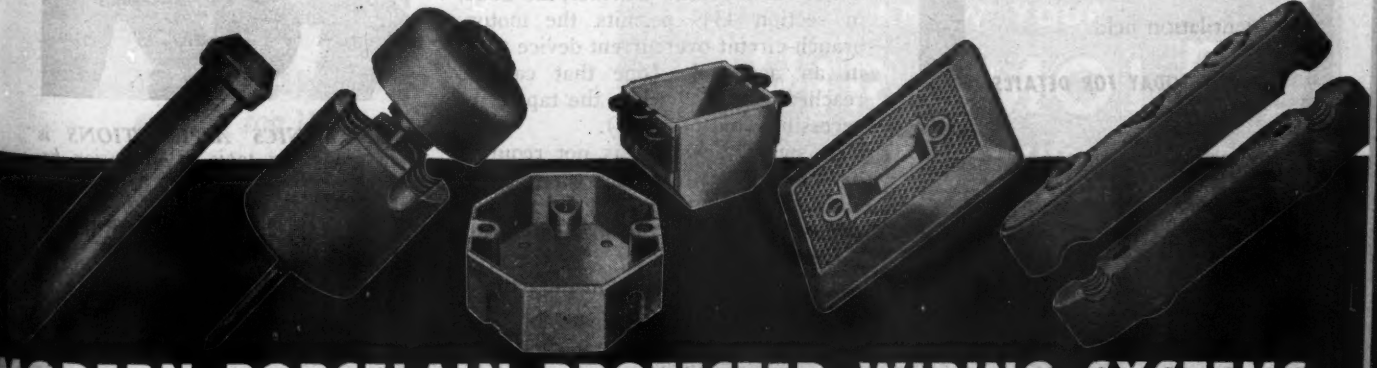

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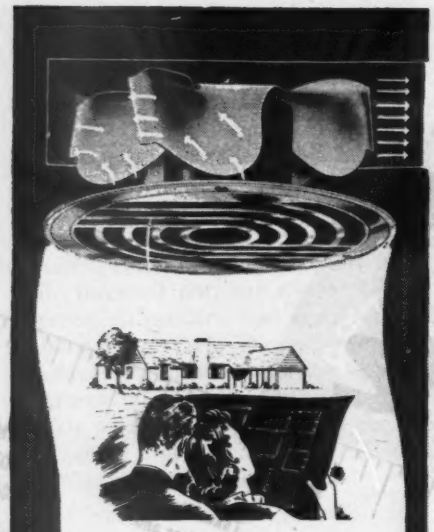

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ground this section of raceway. Has this section of the Code been changed?" —F.P.

A. No, as yet this section of the N.E. Code has not been changed; however, its intent is confusing. The system grounding conductor referred to in this section is the grounding wire between the service equipment and the grounding electrode or water pipe connection and not the grounded conductor or neutral of each circuit.—G.R.

USE OF GRAPHITE

Q. *"On a recent installation we had difficulty in pulling feeder conductors through a rather long conduit and finally resorted to dry graphite as a lubricant. A test of the insulation resistance after the conductors were in place indicated that the insulation had not been damaged, but we have been told that graphite is a conductor of electricity and might cause premature insulation failure. Does the Code permit the use of graphite for a lubricant or must talc be used."*—K.S.

A. Even though graphite consists of from 50 to 95 percent carbon, the N. E. Code under Section 3033 permits the use of graphite, talc or any approved compound as a lubricant in inserting conductors in raceways.—G. R.

BUS-DUCT SWITCHES

Q. *"In a bus duct installation, mounted eleven feet from the floor, is it necessary to have poles at various points in the building, so that switches mounted on bus duct can be opened from the floor?"*—W.J.S.

A. No, it is not necessary to have switch poles at all as it is not necessary to have switches or fuses or circuit breakers where taps are made from the busways.

The Code in Section 3808 requires that all switches shall be accessible and by the definition of accessible this requires that switches shall not be guarded by elevation, that is, they shall not be out of reach. Further, the Code, in section 4349 permits the motor-branch-circuit overcurrent device to be in an accessible (one that can be reached) location when the tap is inaccessible (out of reach).

A switch however, is not required by the Code at the point where a tap is made, so both the switch and the protective device can be located within reach.

However, the busway manufacturers have seen fit to make fittings incorporating both switches and protective devices for making taps from the busways. Also many inspection authorities, knowing that plants which use busways generally employ one or more maintenance electricians, consider that the plant is under constant and competent supervision and that with switch hooks the tap device is sufficiently accessible and they therefore permit the tap device to serve as a motor disconnect and motor-branch-circuit protective device.

Thus it is seen that there is no Code rule definitely governing the matter, but that it is a question of interpretation by the inspection authority having jurisdiction.

Therefore if the inspection department is willing to accept the switch-hook as rendering the tap off device accessible, the installing electrical contractor should provide as many switch-hooks as the inspector requires.—F.N.M.S.

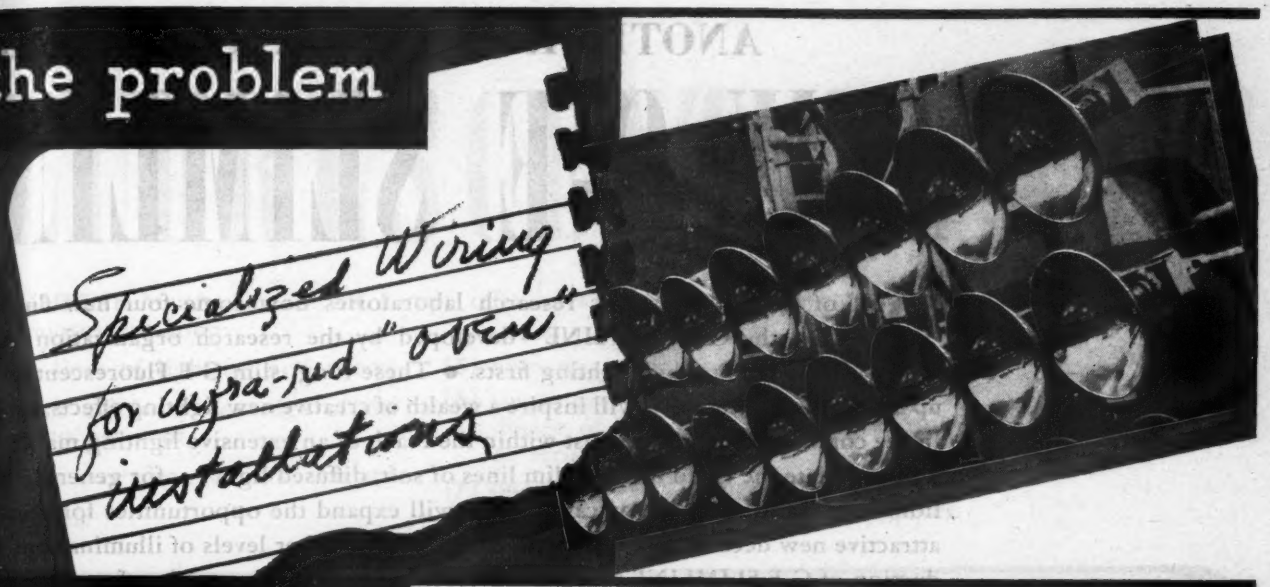
FIXTURE WIRING

Q. *"We are rewiring a cafe in which the owner wishes to hang some fixtures constructed of wagon wheels and oxen yokes. Can ordinary fixture wire be pulled through drilled holes in the wooden spokes of the wheel and through the wooden yoke?"*—B.F.

A. No, such drilled holes would have to be lined with metal or an approved armored or lead covered conductor with suitable fittings will have to be used. This requirement is covered by Section 94101-a of the N. E. Code.—G.R.

ELECTRONICS APPLICATIONS *is the pre-session topic of discussion between A. J. Germain (left), electronics section, Westinghouse Electric & Mfg. Co., and J. E. Fivecoat, electrical inspector of Kokomo, Indiana at a recent Western Section, I.A.E.I. meeting in Indianapolis.*

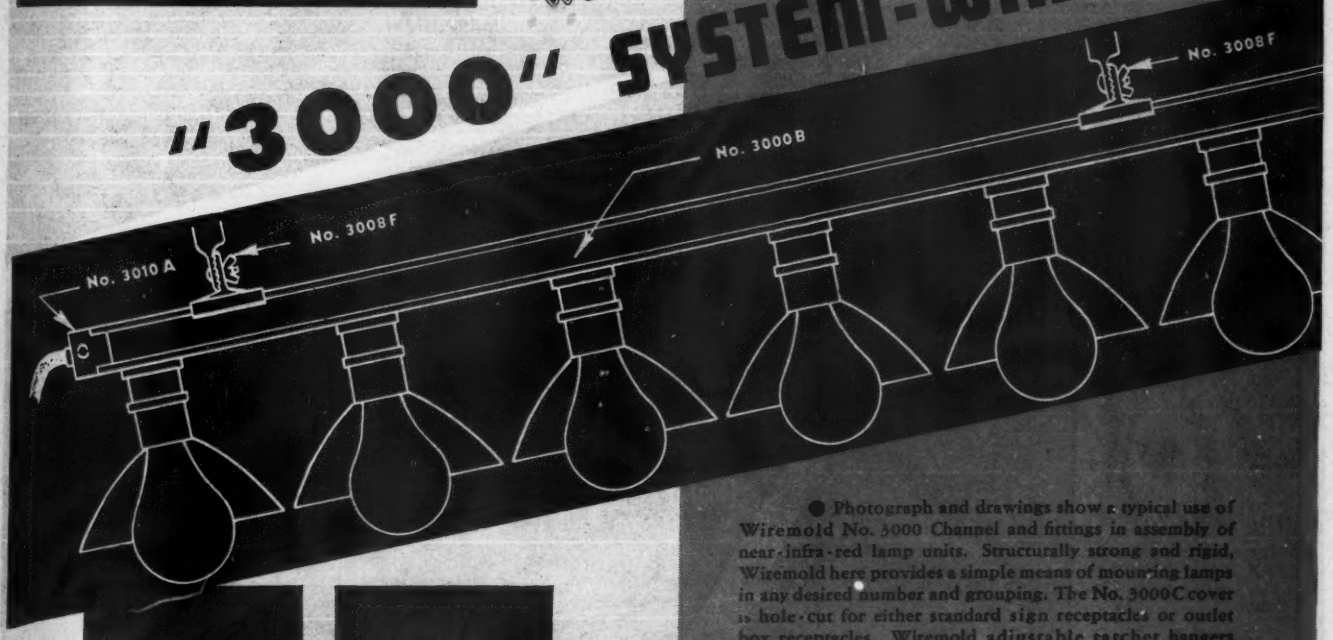
the problem



the answer

WIREMOLD

"3000" SYSTEM-WIRING



VIEW FROM FRONT

VIEW FROM REAR

● Photograph and drawings show a typical use of Wiremold No. 3000 Channel and fittings in assembly of near-infra-red lamp units. Structurally strong and rigid, Wiremold here provides a simple means of mounting lamps in any desired number and grouping. The No. 3000C cover is hole-cut for either standard sign receptacles or outlet box receptacles. Wiremold adjustable ratchet hangers (3008F) permit necessary adjustment in the banks. Wiring is safely enclosed and protected with channels.

We present this as a specific example of the many hundreds of different ways in which Wiremold is today helping industry gain efficiency while saving time and expense in meeting specialized wiring and lighting needs.

Send for new Industrial Wiring Bulletins and engineering data sheets.

WIREMOLD CAN HELP YOU PRODUCE FOR WAR . . . WHILE YOU PLAN FOR PEACE!

KNOW YOUR

WIREMOLD

AND YOU KNOW THE ANSWERS

NEMA

THE WIREMOLD COMPANY HARTFORD 10, CONN.

ANOTHER PRODUCT OF GENERAL

NEW G-E SLIMLINE

OUT of General Electric's research laboratories now come four new fluorescent lamps—the G-E SLIMLINE—developed by the research organization that has originated so many other lighting firsts. ● These long, slim G-E Fluorescent Lamps—up to eight feet in length—will inspire a wealth of creative new lighting effects, especially in the commercial field, at a cost within the reach of an extensive lighting market. They will stimulate the trend to long slim lines of soft, diffused light . . . for general illumination, cove lighting and showcases. They will expand the opportunities for combining attractive new decorative effects with substantially higher levels of illumination. ● Production of G-E SLIMLINE Mazda Fluorescent Lamps will proceed as fast as conditions permit. We will inform you as soon as they are available.

ELECTRIC LAMP RESEARCH

FLUORESCENT LAMPS!

G-E SLIMLINE Mazda Fluorescent Lamps offer advantages never before combined in any fluorescent lamp:

(1) slim lines of light for new effects

(2) higher efficiency—average of 60 lumens per watt

(3) instant starting, without starters

(4) long life

(5) operation singly, in multiple or in series

(6) single pin base—makes possible a safe design of lamp and socket for multiple or series operation

(7) operation over a range of wattages and current values—100 to 200 milliamperes.

GENERAL ELECTRIC SLIMLINE MAZDA FLUORESCENT LAMPS

Lamp		Current (Milliamperes)	Lumens (Approx.)
42T6	Nominal Length *42″ Outside Bulb Diameter ¾″	100	900
		200	1400
64T6	Nominal Length *64″ Outside Bulb Diameter ¾″	100	1400
		200	2150
72T8	Nominal Length *72″ Outside Bulb Diameter 1″	100	1400
		200	2350
96T8	Nominal Length *96″ Outside Bulb Diameter 1″	100	1950
		200	3300

Standard 40-watt F lamp, shown for comparison

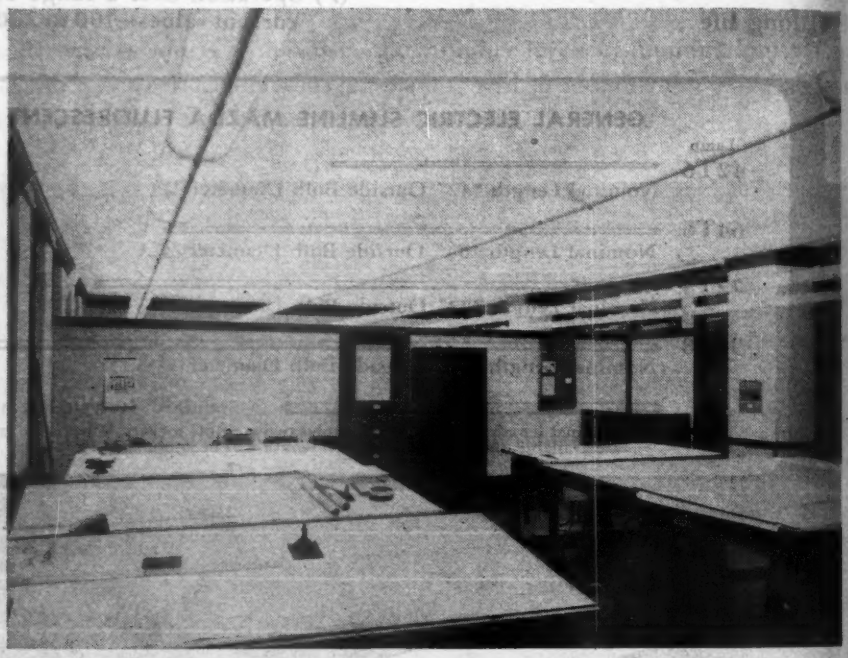
*Nominal length includes one lamp plus two multiple sockets. When series sockets are available, the increase in overall length will be announced.

GENERAL ELECTRIC

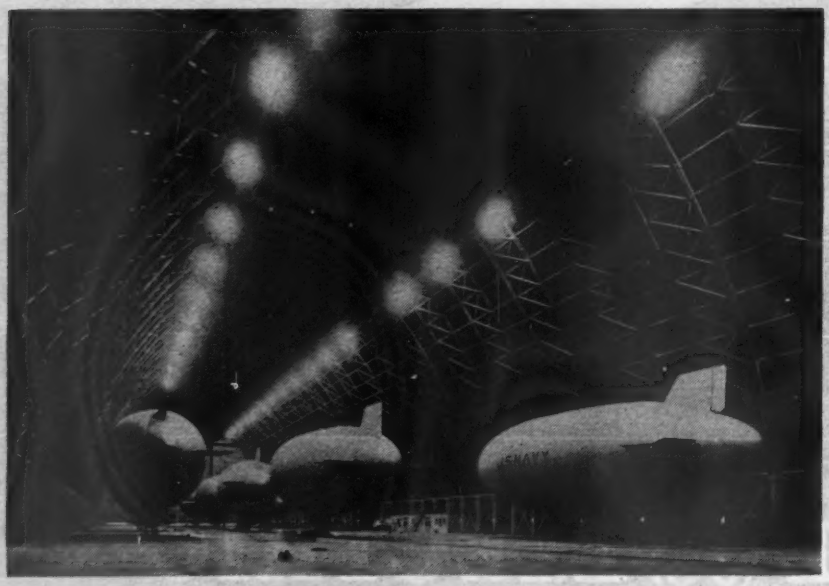
MODERN LIGHTING

MERCURY LAMPS LIGHT HANGER

The large blimp hangars at Moffett Field, California, which house the U. S. Navy training blimps are illuminated by the new Westinghouse 3000 watt mercury lamps. The blimps are placed in large new hangars such as this one, to be serviced, repaired if necessary, and made ready for the following day's work of training personnel to man the larger patrol blimps which guard our Pacific shores and sea lanes. Adequate general illumination for this hangar—which is approximately 1,000 feet long, 300 feet wide and 175 feet high—is provided by 42 of the three kw. high intensity mercury lamps in open-end porcelain enameled steel reflectors. Suspended beneath catwalks, which are used for periodic cleaning and servicing the units, the lamps and fixtures are mounted 133 feet above the hangar floor, and in two parallel rows 95 feet apart. Individual fixtures in the parallel rows are 48 feet from center to center. Average illumination on the hangar floor is seven foot-candles. Local lighting for close work beneath the big training blimps is provided by flood and spotlights mounted at either side of the huge hangar, or by portable lighting units. High intensity mercury tubes in the high-mounted reflectors are 1⅛ inches in diameter and 4½ feet long. Each three kilowatt tube produces 120,000 lumens of light—40 lumens per watt—or approximately the same amount of light which would be given by four 1,500-watt incandescent lamps in suitable reflectors.



***CONTINUOUS-ROW LIGHTING** on five foot centers at an eight foot mounting height provides 70 foot-candles of glareless light on tracing paper. Paint with high reflection factor and control of window light give an even illumination distribution.*



***BLIMP HANGAR** illuminated by three kw. mercury lamps with units mounted 133 feet in the air provides the floor area with approximately seven foot-candles of light.*

DRAFTING ROOM LIGHTING

In order to provide illumination for fine drafting of a quality approach-complete diffusion of light, to avoid ceiling glare from tracing cloth, and also to provide maximum visibility for fine lead-pencil lines, lighting engineers coordinated artificial illumination with interior decoration and natural light control to fulfill seeing requirements.

The drafting room area is 25 feet by 56 feet (1400 sq. ft.) with a 10-foot ceiling finished in white painted plaster with an initial reflection factor of approximately 90 percent. A solid partition seven feet four inches high runs across the width of the office dividing the lengthwise dimension into 34 feet and 22 feet. The photograph shows the larger area. Wall surfaces are of cream-painted plaster with a reflection factor of 55 percent. Floors are brown-painted wood with a reflection factor of 11 percent. Drafting tables occupy over 50 percent of the area. These are covered with a buff hard paper with a 76 percent reflection factor. Windows are on the west

it's easy to see when it's "Day-brite"

Quality will always remain a powerful selling force, especially with Day-Brite—where quality is easy to see.

Because Wholesalers, Contractors and Dealers know this, their present and postwar thinking naturally includes the complete Day-Brite Line. It adds profitable support to their business reputation.

Whether you think of light, or quality, remember —It's Easy to See When it's Day-Brite!

Consult your nearest Day-Brite Engineering Representative.

DAY-BRITE LIGHTING
Incorporated
5437 Bulwer Ave. St. Louis 7, Mo.

THE SIGN OF *Quality* LOOK FOR THIS LABEL

***The* CORONADO**
(pictured above)

A shielded-type unit, with diffuse glass side panels, and louvered bottom to prevent bug catching and make cleaning easy. Surface or suspension mounting. For complete details, write for Bulletin F-80.

Day-Brite
LIGHTING FIXTURES

Nationally distributed through all leading electrical supply houses

Improved

for greater usefulness

Watertight Socket fits snugly on side of lamp.

Concave Wire Outlet with pliable rubber opening that grips wires tightly and effectively seals end of handle.

New Features for

Popular 7000 Guard Series

Guards in every sense of the word . . . the new McGILL 7000 Series protects not only light bulb but all connections to it.

Note in the illustration above the Watertight rubber socket and the rubber seal in the handle end . . . both of which prevent seepage of water and moisture to the interior. Connections, light bulbs, users . . . all THREE are protected by this new McGILL construction, every detail of which passes the rigid requirements of Underwriters' Laboratories. This guard can also be furnished with McGILL composition socket if desired.

There's a size and type for every need . . . in industrial plants, garages, railroad work, etc. Write for complete details.

McGILL MANUFACTURING CO.
Incorporated

VALPARAISO, INDIANA

Electrical Division

McGILL

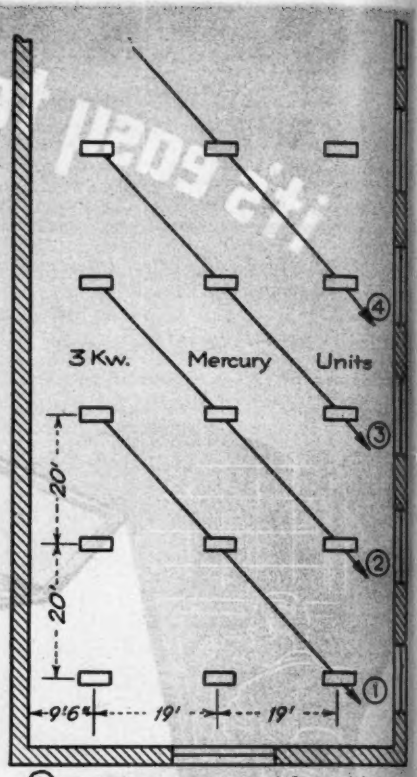
and north walls. Those on the west are equipped with venetian blinds to control glare from daylight. Roll shades are used on the windows along the north wall.

The general lighting is provided by five continuous rows of luminous indirect luminaires equipped with plastic reflectors. Each row is 52 feet long, spaced five feet apart, suspended 2 feet 4 inches overall, and contains two parallel rows of 48-inch white fluorescent lamps. Each lamp serves 10.77 square feet with a gross loading of 4.53 watts per square foot. Lighting units were designed and manufactured by Ainsworth Lighting Inc.

The system had been installed four months and had been used approximately 400 hours when lighting measurements were taken based on the IES method of measurement. An average of 72.58 foot-candles was found 39 inches above the floor. Brightness values were as follows: unit normal to length, at an angle of 45°—296 footlamberts; ceiling directly above units—115 footlamberts; ceiling between rows —79 footlamberts.

Wiring is simplified by using each row as a wiring channel. Five outlets serve as feeders which are run in Wiremold raceway extending from the south wall on the ceiling along the plane of the partition mentioned above.

Sheen on the working surface was not discernible, and shadows were not apparent.



①—Indicates Diagonal Circuiting

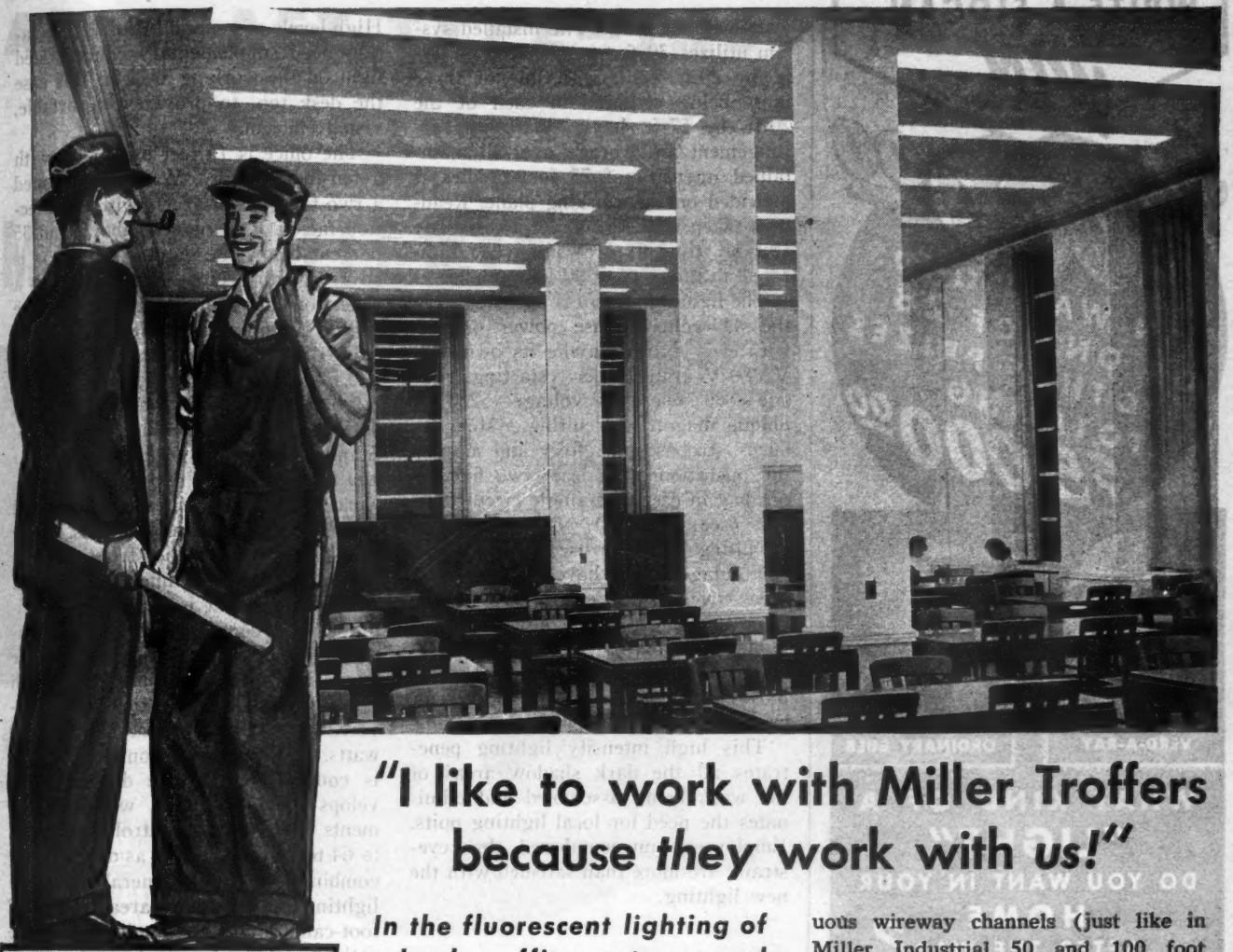
DIAGONAL CIRCUITING reduces stroboscopic effect and assures operation of two lamps per bay.

75 FOOT-CANDLES IN ASSEMBLY BAY

Good lighting is the rule at the Cross Company, Detroit machine tool manufacturers. It means better quality workmanship, fewer rejects and accidents and a general boosting of efficiency. With this in mind, the management had a high intensity lighting system installed in a new 57-ft. by 270-ft. assembly bay addition designed by H. E. Beyster Corp., Detroit architects and engineers.

Since the mounting height was to be 35 feet, they wanted a light source that would provide the necessary illumination punch on the working plane. They chose the relatively new 3-kilo-

HIGH INTENSITY hi-bay lighting using the new 3-KW mercury unit provides the illumination punch necessary in the machining and assembly bay of this Detroit machine tool manufacturing plant. Average over-all intensity—75 foot-candles.



"I like to work with Miller Troffers because *they* work with *us!*"

In the fluorescent lighting of schools, offices, stores and industry . . .

new lighting systems need not present new planning problems nor new construction problems. In fact, the Miller 2-lamp 40-watt Fluorescent Troffer not only avoids *new* problems—but ingeniously solves a few *old* ones!

ARCHITECTS SAY that Miller Troffers in single units, combinations of units, or in continuous light-strips "by the mile" present almost unlimited application possibilities. The wide range of plastic and glass dishes, ribbed or fluted—and prismatic glass plates—and grills of metal or plastic—harmonize with almost any type interior.

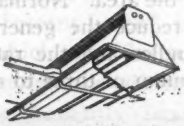
BUILDERS AND CONTRACTORS SAY that exclusive Miller features such as continuous wireway channels (just like in Miller Industrial 50 and 100 foot Candlers), patented brackets and other improvements developed during Miller's 100 years of pioneering make this the most practicable and economical fixture with which to work.

USERS of Miller Troffers say they are amazingly simple to service—and so economical to operate that completely new standards of illumination can be enjoyed.

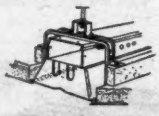
THE MILLER COMPANY SAYS: "We think we've got the best dawgone fluorescent lighting systems in the world—and because we work with all light sources (including mercury-vapor and incandescent), we don't think we're particularly biased."

So call in a Miller Engineer—they're in principal cities — and see why we're starting our *second* 100 years so chockfull of confidence!

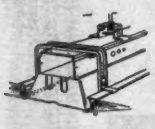
How they work:



Miller Troffer recessed in either plaster or acoustic tile ceiling.



Patented Miller Bracket for attaching to structural ceiling, allowing false wood ceiling to be hung *from the fixture.*



Patented Miller Bracket for attaching to structural ceiling, allowing false metal ceiling to be hung *from the fixture.*

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent Mercury Lighting Equipment

OIL GOODS DIVISION
Domestic Oil Burners and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass in Sheets, Strips and Rolls

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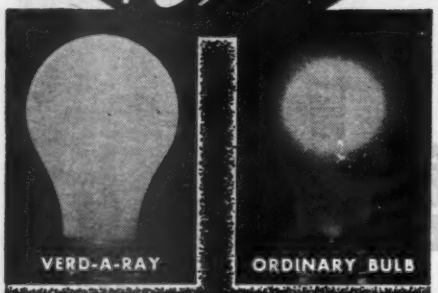
MILLER
SINCE 1844

WRITE A SLOGAN...
WIN
$1,000.00
IN WAR BONDS
OR ONE OF 28
OTHER PRIZES
TOTALING
$5,000.00



WHAT KIND OF A
"LIGHT"
DO YOU WANT IN YOUR
HOME
AFTER THE WAR?
SEE THIS NEW LIGHT
AT YOUR DEALER'S

● VERD-A-RAY is a new type of incandescent light bulb scientifically designed to make seeing easier. In comparison with the "pinkish" white light of ordinary frosted lamps, note the comforting "pastel greenish" white light emitted by VERD-A-RAY.

Scientific research data indicates improved visual (sharpness) acuity, relief from eyestrain and reduced glare.

Many war plants use VERD-A-RAY; one such plant reporting in a trade paper that hospital treated headaches were reduced 69.13%, hospital treated minor accidents were reduced 54%, and 357 productive manhours were saved in one department in one month after proper installation of this new "glareless" lamp.

Nothing to buy. Your dealer has entry form and rules of contest. If not, write direct. Any combination of six words or less, descriptive of VERD-A-RAY may win a prize.

SEE YOUR DEALER
OR WRITE TODAY
VERD-A-RAY
CORPORATION
TOLEDO 5, OHIO

watt mercury unit. The installed system utilizes 39 fixtures, spaced on 19-ft. by 20-ft. centers—a line of three units being centered in each of the 20-ft. by 57-ft. bays. With this arrangement an average over-all maintained intensity of 75 foot-candles is provided on the working plane. Readings taken in the center of a three-bay section (nine fixtures involved) indicated an intensity of 90 foot-candles.

The lighting system is operated from the 440-volt, 3-phase power circuits with each fixture having its own 440-V/880-V transformer (starting voltage—880; operating voltage—525). A unique diagonal circuiting system reduces stroboscopic effect and assures the operation of at least two fixtures per bay in case of a single circuit outage (see diagram). If straight-line circuiting had been used, a single circuit outage would have meant a dark area covering an entire bay or the same section of three adjacent bays (unless alternate straight-line circuiting was used). Each circuit of three fixtures is controlled by a circuit breaker in panels mounted on the walls.

This high intensity lighting penetrates all the dark shadow areas of the work being assembled and eliminates the need for local lighting units. Employees, unencumbered by eyestrain, are more than satisfied with the new lighting.

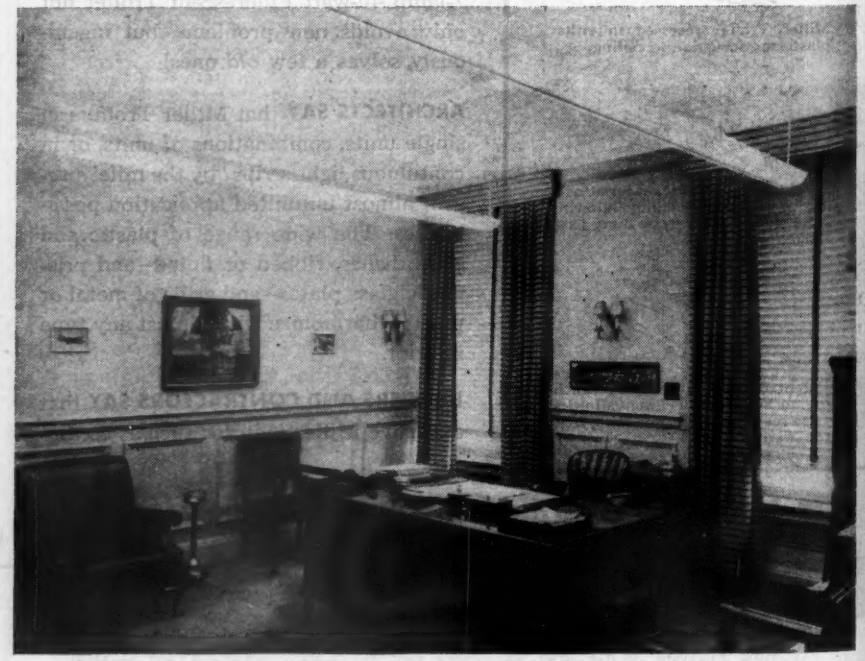
PRIVATE OFFICE ILLUMINATION

Executive office illumination requirements are similar in most cases to general office and industrial lighting. High levels of general diffuse illumination need supplementary concentrated light on the working area, in this case the desk top, to provide comfortable, visual efficiency.

The office is 15 feet by 19 feet with a ten-foot ceiling. Walls are painted a two-tone pastel green with a reflection factor of 44 percent above and 35 percent below the dado. The floor is covered with a taupe carpet and has a reflection factor of nine percent. The ceiling is finished in felt and cloth painted white and reflects 80 percent.

After 100 hours of use, general lighting averaged 43 foot-candles with 54 foot candles on the blotter (I. E. S. Standard Method of Measurement) and is provided by two rows of Ainsworth "Spacialite" luminaires, a total of 8 four-foot two-lamp sections. These are suspended 20 inches from the ceiling and seven feet, nine inches apart.

The down-light is flush in the ceiling and is composed of five concentrated mirrored-glass reflectors above louvers and heat absorbing glass. Each reflector contains one three-light silvered bowl lamp rated 50/100/150 watts. Illumination from this source is concentrated on the desk and develops 88 foot-candles with all filaments on. Switch control varies this to 64 to 25 foot-candles as desired. The combination of the general and local lighting on the work area totals 142 foot-candles initial illumination. The ratio of 1.6 to 1 provides a low contrast between the immediate field and the surroundings, and adds to the overall comfort of the area. Normal depreciation may reduce the general level to 25 foot-candles and the ratio may reach a maximum of three to one.



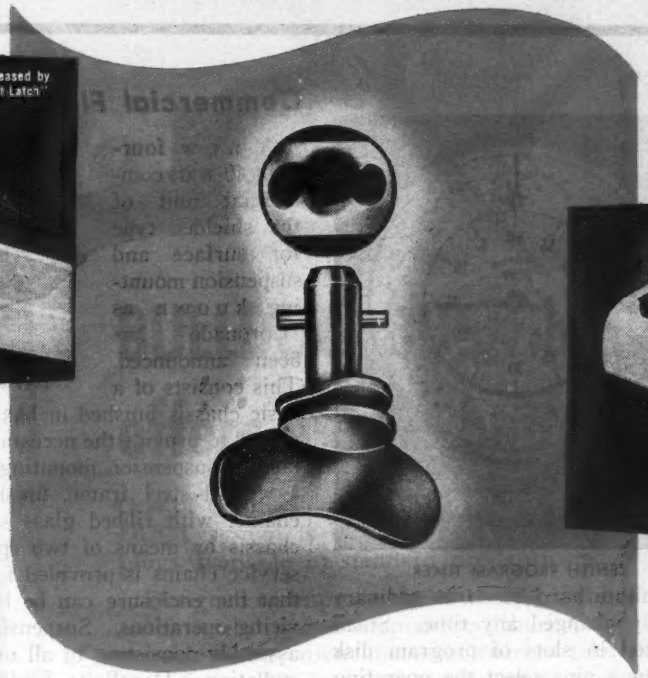
EFFECTIVE SEEING conditions are established by this engineered illumination design based on the principle of spatial brightness equilibrium.

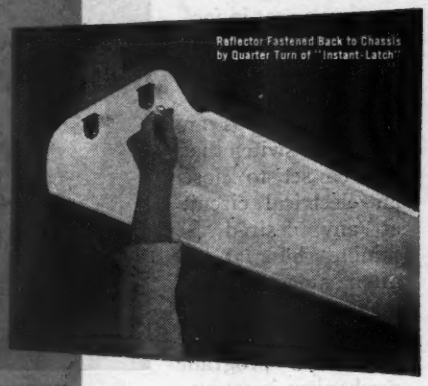
AIRCRAFT TYPE—INSTANT-LATCH

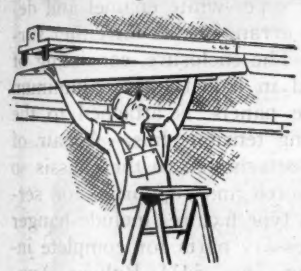
Speeds Installing, Cleaning, Servicing

OF THE NEW

MITCHELITE ALL-STEEL FIXTURES







A simple quarter-turn of Mitchell's new aircraft type "Instant-Latch" attaches or releases the reflector . . . instantly. No tools needed. This "Instant-Latch" is a strong cam-type fastener which provides positive tension at all times. No amount of vibration will loosen it. All parts permanently attached—no fussing with small removable parts. No spring to wear out. Two such latches are secured on each reflector.

This is only one of the many MITCHELL features that make it easier than ever to install, clean and service the new MITCHELITE All-Steel Industrial Fluorescent Fixtures.

The new MITCHELITE is available in 2-40 watt, 3-40 watt and 2-100 watt models . . . in open-end and closed-end types . . . including new, perfected 2-40 watt "Instant-Start" units . . . with choice of Baked Enamel or Porcelain Enamel finish. U/L and E.T.L. approved throughout.

FEATURED ON BOTH OPEN-END AND CLOSED-END TYPES

MITCHELITE Accessories provide for every method of mounting or hanging . . . individually or in continuous rows.

MITCHELL FLUORESCENT

Get full details from your MITCHELL DISTRIBUTOR or write for Catalog No. 281

MITCHELL *Manufacturing Co.*

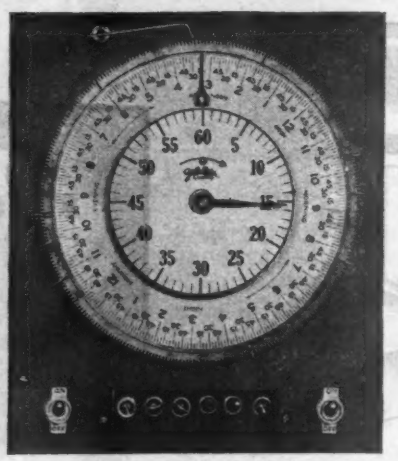
2525 Clybourn Avenue **Chicago 14, Illinois**

West Coast Factory and Sales Office: 1019 N. Madison Ave., Los Angeles 27, Cal.

THESE ANNOUNICEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS

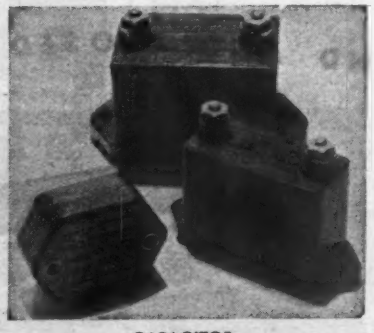
Program Timer



ZENITH PROGRAM TIMER

This new program timer is designed for numerous uses in factories, airports, railroads, schools, hotels and many other institutions. It is an automatic switch that can be set to close an electrical circuit at any desired 5-minute interval as often as desired. As many as 288 operations a day are possible. The program mechanism is set automatically by turning the minute hand as on an ordinary clock. The schedule is easily changed any time. Small spring brass clips are inserted in slots of program disk for the program desired. These pins select the operating times. Operation is performed by a set of cam-operated contacts. Silver contacts operate with snap action. Rating 10 amps. at 110 volts. Steel case is 8-in. by 12-in. by 4-in. Zenith Electric Co., 152 W. Walton St., Chicago 10, Ill.

Capacitors



CAPACITOR

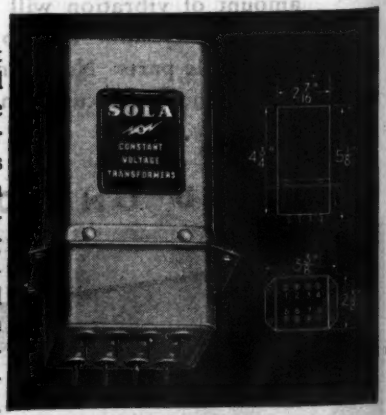
Lectrofilm capacitors which are mechanically interchangeable with mica capacitors type CM60, 65 and 70 as listed in American War Standards Spec. C75.3, have been announced. They are available in case -60, -65 and -70 types. Lectrofilm is a new synthetic dielectric material developed especially for capacitors. These capacitors are suitable for radio frequency blocking and by-pass applications in communications and other electronic equipment. The internal foil and lectrofilm assemblies are arranged for minimum inductance and low foil losses. They are treated to assure a rigid assembly and permanence of characteristics under vibration, shock and wide temperature changes. They are supplied in green, low-loss plastic cases which guard the interior assembly against moisture. General Electric Co., Schenectady, N. Y.

Commercial Fluorescent Unit

DAY-BRITE CORONADO

A new four-light 40-watt commercial unit of the shielded type for surface and suspension mounting known as "Coronado" has been announced. This consists of a basic chassis finished in baked super-white enamel and designed to provide the necessary arrangements for either surface or suspension mounting. The enclosure, consisting of a welded steel frame, finished in baked lustre aluminum enamel with ribbed glass side panels, is attached to the chassis by means of two spring tension clips. A pair of service chains is provided for attachment to the chassis so that the enclosure can be lowered and supported for servicing operations. Suspension type fixtures include hanger assembly consisting of all necessary parts for complete installation. Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis 7, Mo.

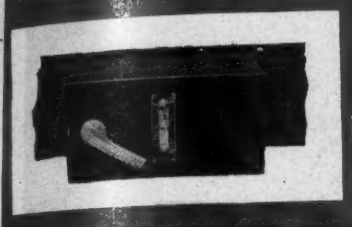
Transformer



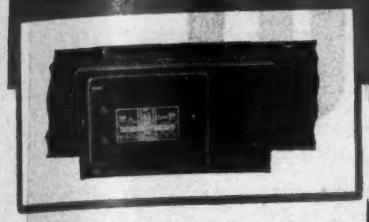
SOLA TRANSFORMERS

This small, compact hermetically sealed Sola constant voltage transformer for through-chassis mounting, has been designed for such applications as heating and refrigeration controls, television and FM receivers, vacuum tube voltmeters, electronic gaging and inspection equipment, photometric instruments and other similar applications where precisely regulated supply voltage is mandatory. At any reasonable transformation ratio of input to output it will provide a single output voltage constant to within plus or minus 1 percent of rated requirements regardless of line voltage variations as great as plus or minus 12 to 15 percent. Capacities up to 15 va. 60 cycle operation are available and are supplied with a separate capacitor unit for external mounting. This transformer has no moving parts, is self-protecting against short circuit. Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill.

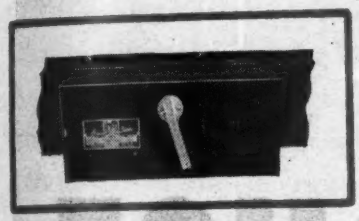
For every circuit protective purpose



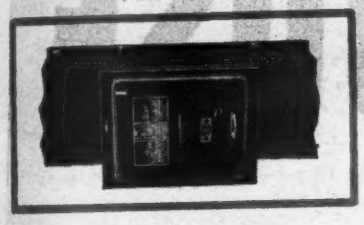
VACU-BREAK SWITCH PLUG



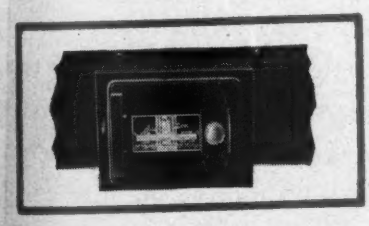
TYPE "PB" BUS PLUG



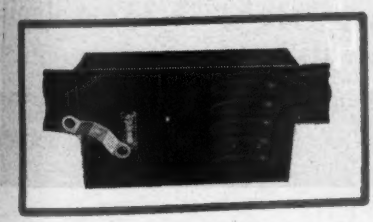
CIRCUIT BREAKER PLUG



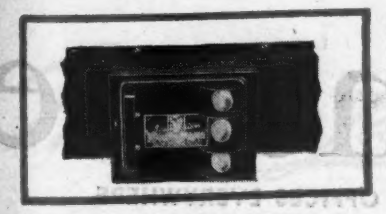
CIRCUIT MASTER PLUG



TEMPERATURE INDICATING PLUG



CAPACITOR PLUG



GROUND DETECTOR PLUG

BULLDOG BUStribution DUCT offers a plug *built for the job*

One of the outstanding advantages of the BullDog BUStribution DUCT system is the wide variety of circuit protective tap-off plugs available in standard pre-fabricated types.

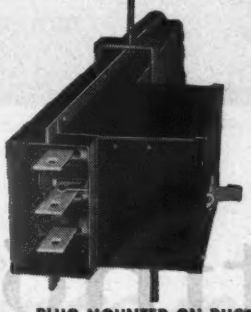
Designed to improve the efficiency of the system through maximum flexibility and adaptability, the standard BullDog Bus Plugs provide a convenient means of current take-off that is completely interchangeable for type, volts, poles and sizes.

All Bus Plugs fasten securely to the flanges of the duct section at the plug-in openings, may be mounted on either or both sides of the duct and require no auxiliary screw clamps or fittings.

Plugs may be removed from duct and moved to a new location at a minimum of labor expense and with no material loss, permitting rapid rearrangement of production machinery to meet expansion programs, change-overs or new production methods.

For complete information on the various BullDog Bus Plugs illustrated in this advertisement, write for our illustrated bulletin 427-2.

Manufacturers of a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.



PLUG MOUNTED ON DUCT
This end view of a plug mounted on duct shows how the copper "contact" fingers of the plug clamp over the bus bars in the duct.

For a Bright Future
Buy More War Bonds

BULLDOG
ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN
BullDog Electric Products of Canada, Ltd., Toronto, Ont.

Field Engineering Offices in All Principal Cities

NEWS ABOUT *a new* WESTINGHOUSE LAMP

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

...FOR STORES, SHOWCASES, ARCHITECTURAL AND DECORATIVE EFFECTS...

New "Slimline" lamps—long, slender and fluorescent—are being made by the Westinghouse Lamp Division. Samples will be available shortly to fixture designers and others interested in the development. These tubes will be 42 and 64 inches long respectively, and have a diameter of only ¾ of an inch. Later, when manufacturing conditions permit, samples of lamps measuring 72 and 96 inches long with a thickness of one inch will be available.

All these lamps will be hot cathode of the instant starting type which do not require starters. They may be operated singly or in multiple with a ballast, or on series circuits with a high voltage transformer. They will be available in the standard white color and will have a new type of single pin base. The life rating 200 milliampere operation will be of the same order as the standard 40 watt fluorescent lamps.

They will present long ribbons of soft, cool light which will be very effective in places where decorative yet highly efficient lighting is required, and where reflector space is limited.

Once again the pioneering spirit of Westinghouse shows the way to better See-Ability with better lamps. Westinghouse Electric & Manufacturing Co., Lamp Division, Bloomfield, N. J.

EFFECTIVE IMMEDIATELY, THE FOLLOWING LIFE RATINGS APPLY ON 40 AND 100 WATT WHITE AND DAYLIGHT WESTINGHOUSE FLUORESCENT LAMPS

Burning Hours per Start	Rated Average Life* (Hours)		% of Initial Lumens per Watt at 70% of Rated Life**	
	40 Watt	*100 Watt*	*40 Watt*	*100 Watt*
3	2500	3000	84	78
6	4000	4500	76	72
12	6000	6500	70	69

*Life under specified test conditions. This includes such factors as operation on AC circuits at rated voltage, the use of starters and ballasts or transformers of proper design.

**All fluorescent lamps depreciate in light output continuously thruout life. Ordinarily the use of fluorescent lamps beyond 6500 hours cannot be economically justified.

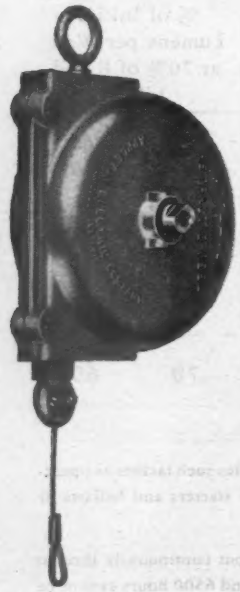
Mazda Lamps FOR SEE-ABILITY

Circuit Breaker

A new 100-amp. "De-ion" circuit breaker which requires less space and permits lighter structures for distribution panelboards, built-in applications and bus duct plug-ins is announced. All ratings are available in one breaker with uniform pole spacings and terminal arrangement, providing complete interchangeability between ratings. The new F frame permits for the first time a 100-amp. 600-volt a-c or 250-volt d-c breaker in the same space formerly required by the 50-amp., 600-volt a-c or 250-volt d-c rating. Equipped with thermal and instantaneous magnetic trip elements, the "De-ion" fuseless circuit breaker permits maximum loading of circuits and fast resumption of interrupted service. Silver alloys used prevent freezing. Both two- and three-pole units are available. Westinghouse Electric & Manufacturing Co., Pittsburgh 30, Pa.

WESTINGHOUSE CIRCUIT BREAKER

Reel for Portable Tools



APPLETON RETRACT-O-REEL

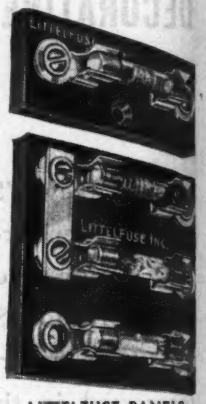
The new Retract-o-Reel is a light-weight all cast balancing reel used for supporting portable tools, as well as air and electrical devices weighing up to ten pounds. Reels support light-weight drills, screw-drivers, assembly tools, etc. directly over production lines while operator is otherwise engaged. When operator has finished using a tool, the Retract-o-Reel lifts tool up over the work and out of the way. Reels have adjustable cable clamps which hold tool in position for easy reach and access. This reel eliminates lost motion and permits high efficiency on production lines. It is furnished with 6- ft., pre-formed wire rope, rubber buckler, cable clamp, and spindle swage eye loop. Appleton Electric Co., 1701 Wellington Ave., Chicago 13, Ill.

Expansion Fitting

This expansion fitting known as Type "TX" is a complete unit designed for thin wall conduits to compensate for expansion and contraction in a line of conduit. It is furnished with extension nipples already in place for quick, easy installation on conduit (E.M.T.) in sizes from ½ in. to 2 in. Special packing seals the head and prevents water or moisture from entering. O. Z. Electrical Manufacturing Co., 252 Bond St., Brooklyn 2, N. Y.

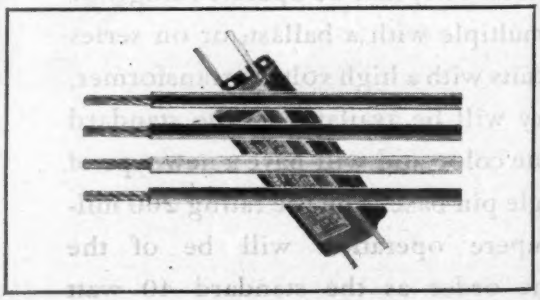
O. Z. EXPANSION FITTING

Fuse Panels



LITTELFUSE PANELS

A new improved Littelfuse Universal fuse panel, No. 1505, has been announced. In airplanes it can be placed at an accessible point, rather than in a central junction box. They are used on shipboard in various signal control points. Industrial laboratories or shop benches use them for holding bars of various diameters. They also serve as temporary switches. The circuit can be opened by pulling out a metal bar from the clips, with insulated pliers. Thus an ammeter can be inserted at this point for a temporary reading. Fuse panel No. 1505 is for Littelfuse 3 AG and 3 AB, 4 AG and 4 AB, and 5 AG and 5 AB Aircorps type of fuses and clips. One number covers the mounting. First dash number indicates fuse specification. Second dash number specifies number of poles. Specifications include bus bars if required and number of poles to be bussed. Light durable panels to individual specifications, meeting all Air Corps requirements come ready to mount, equipped with terminals and fuse clips or terminal studs. Littelfuse Incorporated, 4757 Ravenswood Avenue, Chicago 40, Ill.



G-E LEAD WIRE

Insulated Lead Wire

A new Deltabeston Flamenol thermo-plastic insulated lead wire for use in all types of fluorescent lamp ballasts has been announced. It is approved by the Underwriters' Laboratories for use as lead wire in lighting fixtures wherever 600-volt service is required. It is approved for 176 deg. F. The insulation of this new wire is superaging and is resistant to flame, oils, acids and alkalies. This wire is available in solid and stranded conductors, sizes 16 and 18 AWG in brilliant colors, including black, white, red and green. Deltabeston Flamenol lead wire is mechanically strong and flexible. It will not rupture when bent and is free stripping, easy to splice and terminate. General Electric Company, Bridgeport, Conn.

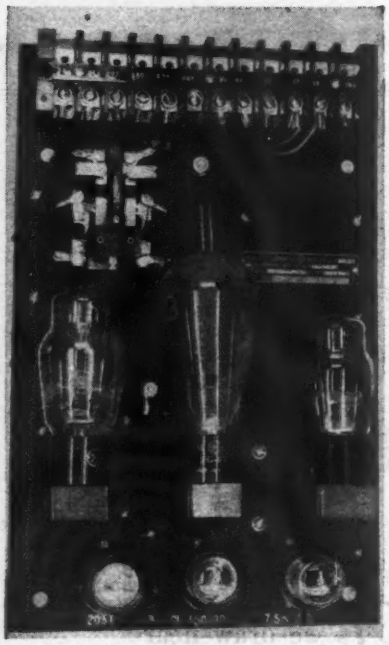
Season's Greetings

As we draw near to the close of a year made difficult by the confusion of global war, we pause to extend the Season's Greetings to our friends and customers and to express our gratitude to those who have been so patient and understanding during the months when we could not give them the Simplex service to which they were accustomed. We sincerely hope that the new year may bring peace to our war-weary world and to each of you a large measure of health, happiness and prosperity.

SIMPLEX WIRE & CABLE CO.

79 Sidney Street, Cambridge 39, Mass.

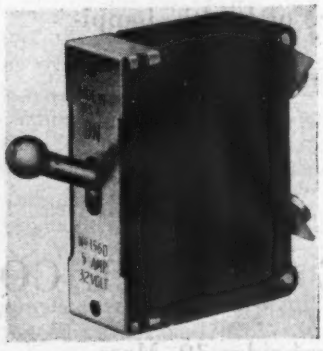
Pressure Timer



G-E TIMER

A new precise electronic forge-pressure timer has been incorporated in the G-E line of capacity discharge controls for use with stored-energy type resistance welding machines. This timer, which is designed for dual pressure spot welding machines of the capacitor discharge type, functions to supply accurately timed forge-pressure, so that the required welding energy, cracks, indentations, and sheet separation are reduced. Calibrated in milliseconds, the timer consists of a timing circuit with a regulated d-c source of voltage to assure accurate timing; the necessary electronic tubes; and a time-delay relay with fixed timing for compensating for the delay in the operation of the solenoid valve on the welding machine. It is mounted on a small steel base so constructed that it can be added to any G-E capacity discharge control already installed, providing the resistance welding machine has a dual pressure system designed for this purpose. General Electric Company, Schenectady, N. Y.

Switch Breaker



LITTELFUSE SWITCH BREAKER

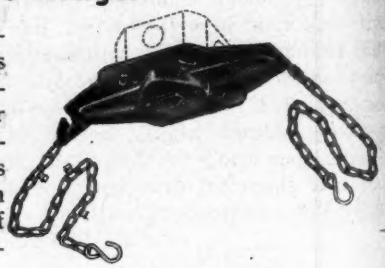
A new circuit breaker relatively free from the effects of extreme high and low temperatures has been announced. The actual trip temperature of the new breaker without flow of current is 350 deg. F., ambient temperature. In the Littelfuse, the bi-metal is used as the finger that pulls the trigger. While primarily designed for military uses, its high time lag adapts it to protection of motors and other equipment having high starting surge currents. The switch breaker No. 1560 is of switch type, non-trip free, performance specification AN-C-77. The range is 5 to 50 amp. at 32 volts a-c or d-c. The breaker is inclosed in moisture-proof black bakelite case. It is panel-mounted by two 6/32 screws, ¼-in. long for 1/16-in. thickness of panels equipped with heavy copper terminal bus bars. Overall size is 2⅛-in. by 2-in. deep below panel by ¾-in. wide. Littelfuse Incorporated, 4757 Ravenswood Ave., Chicago 40, Ill.

Tool for Installing Electrical Connectors

BURNDY HYTOOL

This new Hytool for installing electrical connectors, simplifies the installation of Hyseal thimbles used on Navy, insulated, electrical cable. It eliminates the necessity of a separate pair of dies for each thimble size such as is required in hydraulic presses. The "spade" of the new tool carries a series of holes or dies which provide for installation of a number of thimble sizes, so that no parts have to be changed. Two sizes of the new tool are available. The smaller, No. MYG150N, is used for installing Hyseal thimbles on Navy cable Types DHFA, THFA and FHFA, sizes 14 through 150 and also on Types SHFA and SHFL, sizes 4 through 125. The larger one, No. MYG400N, installs thimbles on Navy cable Types DHFA, THFA and FHFA, sizes 200 through 400 and also on Types SHFA and SHFL, sizes 150 through 400. Burndy Engineering Co., 107 Bruckner Blvd., New York 54, N. Y.

Industrial Fixture Hanger



DAY-BRITE HANGER

A new industrial fixture hanger known as "Hydee" has been developed. This hanger serves the triple purpose in that it provides an outlet box cover with a receptable, a means of supporting chain suspension fixtures, and a grounding arrangement so that fixtures furnished with two-wire cord and plug sets can be used. It eliminates the need of centering, positioning, punching or drilling any mounting holes. This hanger fits any standard 4 in. or 3¼ in. outlet box or open type plaster ring. It is furnished in two 5-ft. suspension chains, cord clips, "S" hooks and receptable. The hanger plate is finished in baked aluminum gray enamel with the chain, hooks and clips in a rustproof finish. Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis 7, Mo.

Industrial Ladder

DUO-SAFETY LADDERS

This new Type "F" industrial ladder is of the channel construction. It is made of duralumin, an aluminum alloy. The ladders are light weight, non-magnetic, non-sparking, and non-toxic. The rounded top rails are inclosed by round end caps. The web steel brackets are faced with fiber wear plates to prevent abrasion. Insulating boots FW-1 and FW-2 have been designed as accessories to the Type "F" ladders. The rubber in these boots is sufficiently heavy to withstand high voltages. No. FW-1 is an insulating rubber boot that fits over the rounded top end of Type "F" ladders. No. FW-2 fits over the bottom of the ladder Duo-Safety Ladder Corp., Oshkosh, Wis.

APPLY THESE TWO IDEAS FOR BETTER PLANT LIGHTING

TAP THE "HOW-TO-DO-IT" ABILITY OF YOUR WESTINGHOUSE DISTRIBUTOR

Your Westinghouse distributor offers two quick solutions to your plant lighting problems.

First: Westinghouse Industrial Luminaires for cool, glareless lighting of industrial areas.

Second: The distributor's own "how-to-do-it" ability representing knowledge drawn from Westinghouse lighting headquarters and experience gained in similar applications for countless other customers.

These industrial luminaires can be quickly installed and easily maintained. Attaching and removing reflectors is a simple "twist-of-the-wrist" job. No tools are required. The hard-finished reflector surface resists scratching . . . is easily cleaned with soap and water . . . repels corrosive and acid vapors . . . retains its high reflectivity.

Westinghouse Industrial Luminaires may be used as single unit or continuous strip installations using either two or three 40-watt or two 100-watt Mazda F Lamps. Ask your Westinghouse distributor today to recommend the proper type for your plant.

J-90526

GET THIS BULLETIN

This bulletin—B-3265—gives you complete information on Type 2 FNR-40 and FNR-100 Westinghouse Fluorescent Luminaires. Both are described in detail . . . also included is data on mounting and spacing of units . . . dimensions . . . and installation. Ask your Westinghouse distributor for your copy today. Or, write Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

SEE YOUR WESTINGHOUSE DISTRIBUTOR *FIRST!*

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Installation Maintenance and Servicing of Electronic Motor Control—I

By B. J. Dalton

Industrial Engineering Division
General Electric Company

WHILE there are specific cases where tubes may be used with a-c motors, adjustable speed d-c drives provide by far the greatest field for application of electronic tubes in motor control circuits. Direct-current motors may be controlled by tubes in two ways:

1. Where the entire motor power is supplied through power rectifier tubes from an a-c line
2. Where the armature power is obtained from a d-c generator or other source, and tubes are used to excite and control the field of either the generator, or motor, or both.

While this article will deal primarily with the former, the problems involved in either of these two systems or in any combination of several motors and their control are similar. This article may, therefore, be used as a guide in working with any of these systems.

Installation

Before starting the actual installation of electronic control it is well to be sure that it is properly located, and that the proper material has been accumulated. The connections and conduit runs can be made more easily and with greater facility if a little time is spent in becoming familiar with the various items and how they fit together to make the complete drive. This, together with a few simple checks, will help make installation of the drive a short job.

Location of Equipment

One of the best ways to obtain long life and trouble free operation is to locate the equipment so that:

1. It will not be subjected to temperature variations beyond the limits for which it is recommended;
2. It will not be subjected to vibration unless it is especially designed to withstand it;
3. It will be protected against dirt, oil, excessive humidity and corrosive atmospheres.

Electronic equipment has definite temperature limitations the same as any other electrical equipment. Most motors, transformers, contactors and capacitors are designed to operate in a maximum ambient temperature of about 104° Fahrenheit (40° C). Most electronic equipment, including mercury or gas-filled tubes, has this same upper limit.

INSTALLATION and maintenance of electronic motor control should be methodical and well planned.

Most electronic equipment, unless it has mercury-type tubes, will operate in ambient temperatures which are below zero. Equipment with mercury-filled tubes, though, should not be operated in ambients below about 50° Fahrenheit unless special heating units are provided.

The ventilating openings usually provided on tube controls should be kept free so that air may circulate. This is particularly important in high ambient temperatures.

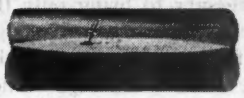
Constant vibration may cause terminals to loosen or wiring and parts to crystallize and break. Vibration should be avoided if possible by mounting the equipment where there is no noticeable movement. If it is necessary to mount equipment where vibration is present if may be necessary to provide springs or rubber bushings to reduce its effect. Sudden shock may also be reduced in this way. It is important that connecting leads be made quite flexible if vibration is present.

Dirt, oil, excessive humidity and corrosive fumes all are enemies of electrical components and should be guarded against. Special baffling should be provided if the control is to be mounted where large amounts of dirt or dust may enter the equipment. Splash or drip shields should be installed if water, oil, or other liquid is likely to splash or drip over the panel, motor, or transformer. Oil or water on components may cause a corrosive action and result in open circuits or short circuits. Tropical climates or

SPERRY ELECTRONIC FLAW DETECTOR

saves $2000 per week in tool breakage!

Rejected bar with only tiny surface flaw noticeable.



Depth and length of same flaw exposed by filing.

Each bar can be inspected at the rate of 80 feet per minute or more. Flaws or inclusions as short as 1/16-inch are detected electronically.

How RCA Electron Tubes Help Locate Hidden Flaws in Bar Stock

THIS is the story of a New England manufacturer* who used electronic inspection to solve his problem of excessive tool breakage.

In machining parts from brass bar stock, invisible flaws and inclusions in the brass caused tool breakage costing over $2000 per week.

To solve the problem, an electronic flaw detector, developed and manufactured by Sperry Products, Inc., Hoboken, N. J., was purchased to inspect all stock before machining. The new inspection method detects defects which would cause tool damage and resulting shut-down. In the first six weeks of operation, *not one tool was broken, tool wear was sharply reduced, and production increased 60%!*

How Does It Work? The Sperry electronic flaw detector consists of an electron-tube oscillator, a detector coil, and a sensitive electron-tube indicator. The oscillator supplies alternating current to the detector. The brass is passed through the detector (see photo). If a flaw is present, the indicator circuit signals the operator and stops the machine. Seventeen small RCA electron tubes are used.

*Name on request

Defects as short as 1/16-inch can be located in both ferrous and non-ferrous materials. The detector works equally well on welded or seamless tubing and on bar stock, and locates external or internal defects, such as splits, seams, and inclusions.

Advantages: In addition to preventing damage to tools and machines, automatic electronic detection improves product quality, reduces final inspection rejections, and prevents failures in the field caused by defective material.

For Further Information on the electronic flaw detector write to Sperry Products, Inc., Hoboken, N. J. If you have some *other* problem involving the use of electron tubes, RCA tube application engineers will be glad to help you or to put you in touch with a manufacturer who can.

For a copy of the free 32-page booklet "Electrons in Action at RCA" which shows electronic devices at work in our own factories, write to Radio Corporation of America, Dept. 62-18C, Harrison, N. J.

Remember, the Magic Brain of all electronic equipment is a Tube . . . and the fountain-head of modern Tube development is RCA!

1919-1944
25 Years of Progress in Radio and Electronics

RCA

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RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION · CAMDEN, N. J.

other extremely humid atmospheres, as well as atmospheres in which acid or other corrosive fumes are present, require special components unless the equipment can be mounted in an area where the atmosphere is controlled. If the equipment is subjected to these conditions, improper operation may result because of leakage paths across high resistance or because of other corrosive action on the various parts.

Identification of Material

A complete drive consists of the following items:

1. A fused disconnecting switch
2. An anode transformer
3. The main control panel with the necessary tubes
4. A control station
5. A shunt wound d-c motor

These items should be checked in detail against the purchase order and the interconnection diagram to be sure that they are correct.

The fused disconnecting switch—is used to isolate the anode transformer and the entire circuit from the main power line. Sometimes a magnetic contactor may be included with the manual switch so power to the anode transformer may be controlled by push buttons. The voltage rating of this switch should be equal to or higher than the a-c voltage. The current rating of the switch and fuses is based on the primary kva. rating of the anode transformer.

The current ratings of the fuses should be approximately 250% of the transformer rating. The following formulas show the method for calculating fuse size—

Single-phase transformer:

$$\text{Fuse size in amps.} = \frac{\text{Transformer primary kva.} \times 2500}{\text{a-c line voltage}}$$

Three-phase transformer:

$$\text{Fuse size in amps.} = \frac{\text{Transformer primary kva.} \times 1500}{\text{a-c line voltage}}$$

In both cases the fuse should be the standard size nearest to the calculated rating. Example: The transformer for a 1 hp. motor is rated 1.65 primary kva. If the line voltage is 220 volts single phase, the calculated fuse size is 18.75 amps. A 20 ampere fuse should be used.

The anode transformer—takes power from the a-c line and changes it to a voltage which when rectified by the thyratron tubes will be suitable for use on the armature and field of a standard d-c shunt wound motor. Also, it usually supplies (from a separate winding) 110 volts for tube filament transformers and magnetic control devices.

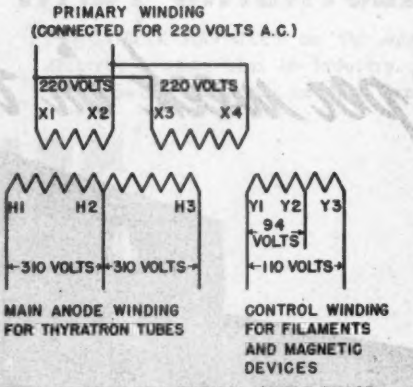

FIG. 1 - DIAGRAM OF A TYPICAL SINGLE PHASE ANODE TRANSFORMER

The primary windings will change for different line voltages, but the secondary connections for single phase equipment will be the same as shown in Fig. 1.

Three-phase or two-phase anode transformers are similar to the single-phase units, but have more primary leads for connection to the polyphase lines and more secondary leads for connection to the larger number of thyratron tubes. The main anode winding has a different voltage than the single-phase transformer. The control winding remains the same as in the single-phase transformer.

The main control panel—consists of three major parts:

1. The rectifiers for the armature and field
2. The electronic control circuits
3. The magnetic control devices

The rectifier for armature power is usually of the thyratron type using phase shifting control so the armature voltage may be varied during starting and operating. The field rectifier, however, may be of either the phanotron or thyratron type. A phanotron rectifier is used to provide a fixed voltage output when the motor field is not to be adjusted. A thyratron rectifier similar to the armature rectifier is provided when the motor field is to be adjusted.

Control of phase shifting of the armature or armature and field rectifiers is accomplished through the electronic control circuits. A further analysis of the operation of these circuits will be made later.

Several magnetic control devices are necessary for protection and operation of the drive. A cathode protective timer prevents the flow of motor current for a definite time after the tube filaments have been energized. A field loss relay prevents starting the motor without field power and will shut down the equipment if the power fails during operation. An overload relay protects the motor against overheating due to overloads. In addition to these protective devices an armature contactor of either the non-reversing or reversing type is provided. A dynamic braking contactor, as well as other magnetic control relays, may also be included.

The control station—may consist of only a "start" and a "stop", or a "forward", a "reverse" and a "stop" push button, and a single speed control potentiometer. A more complicated system of push buttons or limit switches and several speed control potentiometers may be used, though, if some special operating sequence is required. The interconnection diagram will usually show all devices of this type.

The d-c motor—consists basically of an armature and a field. A commutating field and a stabilizing series field are almost always added, however, to obtain good commutation and stable operation.

Although most shunt wound d-c motors are alike internally the terminals may be brought out in several different ways. The armature and commutating field are always connected together internally so that only one side of the armature and one side of the commutating field are brought out. Some motors bring out all six leads to allow flexibility, while others bring out only those actually needed for a particular type of operation. For non-reversing motor operation it is necessary to bring only three leads to the control. For reversing operation it is necessary to connect the shunt and the series fields permanently and to reverse only the armature leads. Fig. 2 shows connections for motors having three, five, or six leads brought out.

It is important to be sure that the motor has been designed (or it is known to be suitable) for operation on a rectifier, otherwise overheating or poor commutation may result.

***INSTRUMENTS** for testing electronic motor control include volt-ohm-meter and cathode ray oscilloscope.*

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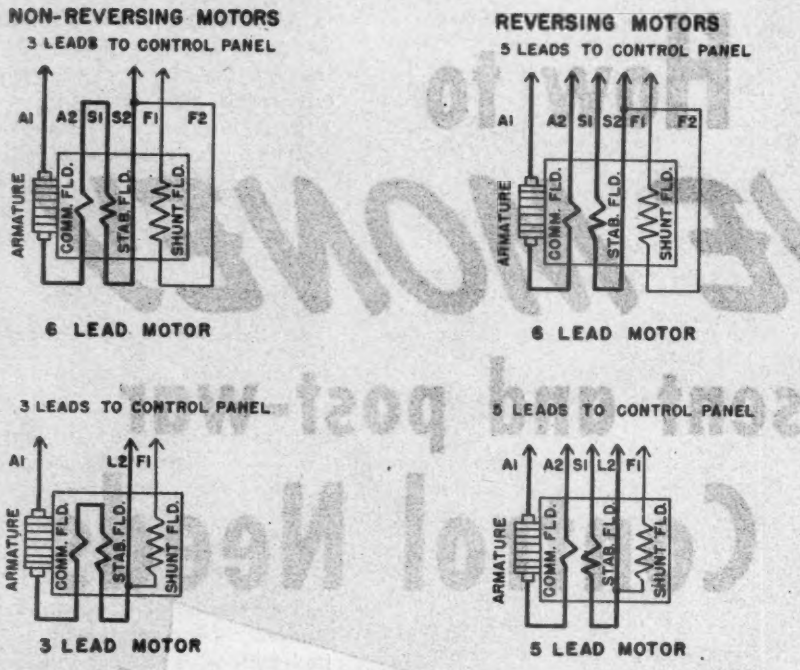


FIG. 2 DIAGRAMS SHOWING VARIATIONS IN MOTOR CONNECTIONS. ALL MOTORS HAVE THE SAME WINDINGS. THE SIX LEAD MOTORS HAVE ALL LEADS BROUGHT OUT, WHILE THE THREE AND FIVE LEAD MOTORS HAVE WINDINGS CONNECTED INTERNALLY.

A smoothing reactor—is sometimes furnished in addition to the items mentioned. This helps to smooth the ripple current that flows in the armature circuit. If a reactor is used it should be connected external to the panel in series with one of the motor armature leads.

Interconnection of Equipment and Preliminary Checking

The interconnection diagram shows the proper connections to be made between the various units. It also may have notes which will be helpful in making connections properly.

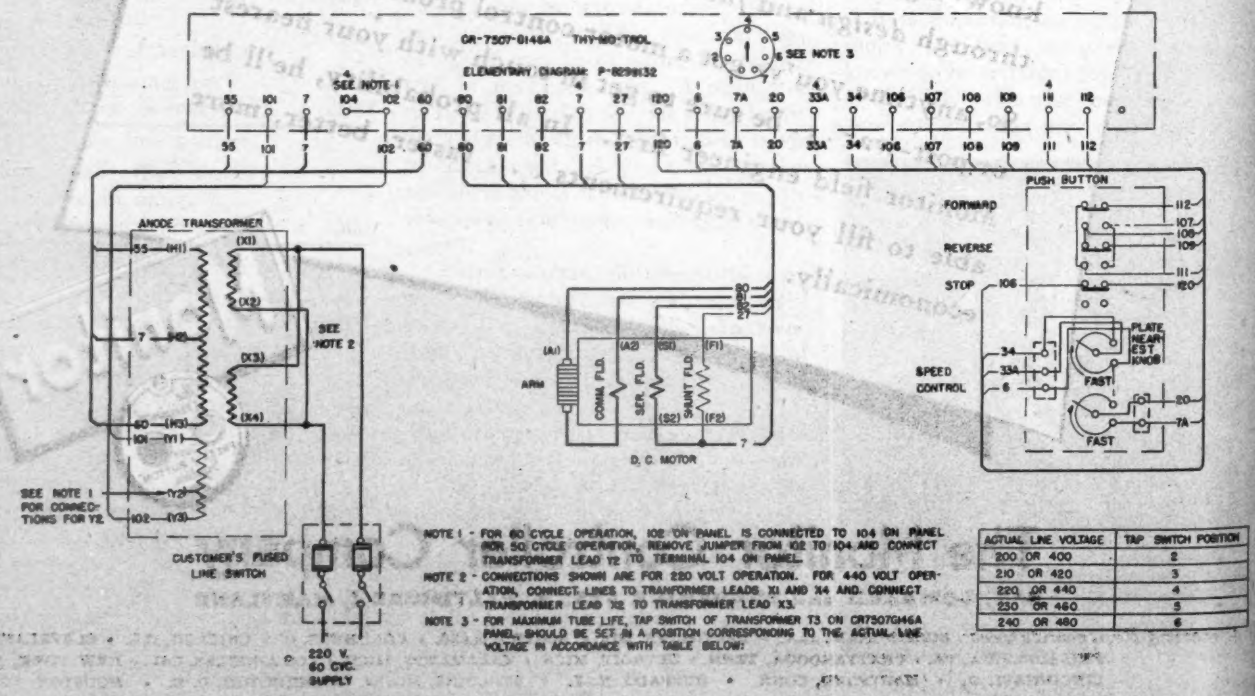
The anode transformer, the motor, and the control station all should have an individual conduit run to the main control panel. The wire sizes should be in accordance with NEMA Standards and Code requirements. If the cables are over about fifty feet long, though, it may be necessary to use larger wire to prevent excessive voltage drops.

The line voltage and frequency rating on the nameplate of the anode transformer should be the same as the power supply. It is important that the secondary connections of the anode transformer be made *exactly* as shown on the interconnection diagram. Otherwise, the phase relations of the voltages will not be correct and the equipment will not operate properly. On two or three-phase anode transformers the phase rotation of the power supply should be the same as indicated on the interconnection diagram.

The control panels are often designed to cover a range of motor horsepower sizes. Also, a particular panel is designed to be used with several different types of motors of the same horsepower size. Because these differences in motors may affect both the armature and field circuit, it may be necessary for the contractor or customer to install the overload relay heater, the field loss relay coil, and the speed limiting resistor in the control panel. The instruction book furnished with the equipment should specify this information in more detail.

Filament Voltage

If maximum tube life is to be obtained, the filament voltage of the thyratron tubes should be held to within plus or minus five per cent of their ratings. Many industrial power lines, however, have voltage levels which are as much as plus or minus ten percent from their nominal ratings. For example, a 440-volt rated line may actually have an average voltage of 470. A 470-volt rated line is about seven percent high. The filament voltage ap-



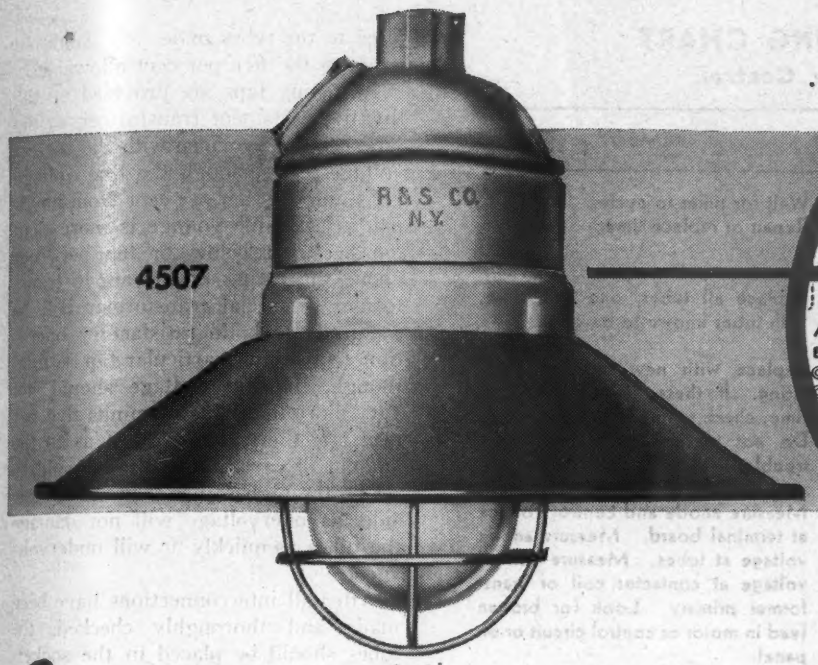
NOTE 1 - FOR 60 CYCLE OPERATION, 102 ON PANEL IS CONNECTED TO 104 ON PANEL FOR 50 CYCLE OPERATION, REMOVE JUMPER FROM 102 TO 104 AND CONNECT TRANSFORMER LEAD Y2 TO TERMINAL 104 ON PANEL.

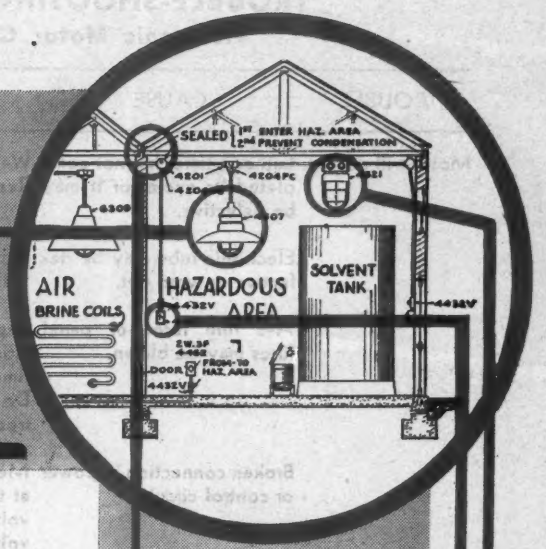
NOTE 2 - CONNECTIONS SHOWN ARE FOR 220 VOLT OPERATION. FOR 440 VOLT OPERATION, CONNECT LINES TO TRANFORMER LEADS X1 AND X4 AND CONNECT TRANSFORMER LEAD X2 TO TRANSFORMER LEAD X3.

NOTE 3 - FOR MAXIMUM TUBE LIFE, TAP SWITCH OF TRANSFORMER T3 ON CR7507G146A PANEL, SHOULD BE SET IN A POSITION CORRESPONDING TO THE ACTUAL LINE VOLTAGE IN ACCORDANCE WITH TABLE BELOW:

ACTUAL LINE VOLTAGE	TAP SWITCH POSITION
200 OR 400	2
210 OR 420	3
220 OR 440	4
230 OR 460	5
240 OR 480	6

LINE VOLTAGE variations can be compensated for by transformer tap switch. All interconnections must follow diagram exactly to maintain phase relations.





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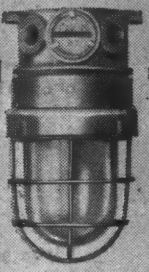

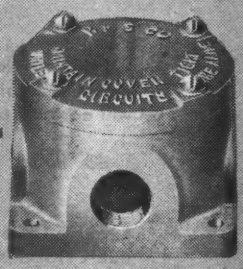

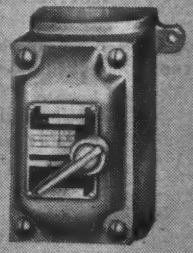

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TROUBLE-SHOOTING CHART

Electronic Motor Control

TROUBLE	CAUSE	REMEDY
Motor will not run	Cathode timer has not completed its cycle, or it may be defective.	Wait for timer to cycle. Repair or replace timer.
	Electronic tube may be defective or worn out.	Replace all tubes, one at a time, with tubes known to be good.
	A-c line fuses or panel fuses may be blown.	Replace with new fuses of same rating. If these blow in a short time, check wiring for short circuits. Do not replace fuses again until trouble is located.
	Broken connection in power or control circuit.	Measure anode and control voltage at terminal board. Measure anode voltage at tubes. Measure control voltage at contactor coil or transformer primary. Look for broken lead in motor or control circuit or on panel.
	Tubes will not light because of open filament transformer.	Measure d-c resistance of filament transformer primary. This should be lower than 200 ohms. If primary is OK check filament voltage at tube socket. If primary is open or if there is no voltage at tube socket replace filament transformer.
	Open grid or control transformer or saturable reactor.	Measure d-c resistance of all windings. In general none should be over 10,000 ohms. Replace if open.
	Open circuited contactor or relay coil. Contactor will not pick up.	Measure voltage across coil. If voltage is present replace coil.
	Field failure relay drops out.	Check field circuit for continuity. Replace defective units.
	Overload relay has tripped out. Frozen machine bearings.	Reset relay and determine cause of overload. With the power off, turn motor by hand to be sure it is free.
	Temperature too low for tubes to ionize.	Install heaters or some other device for increasing panel temperature.
No Control Over Motor Speed.	Electronic tube may be defective or worn out.	Replace all tubes, one at a time, with tubes known to be good.
	Open grid transformer or saturable reactor.	Measure d-c resistance of all windings. In general none should be over 10,000 ohms. Replace if open.
	Defective speed adjusting potentiometer.	Examine potentiometer carefully to see if the internal connections are OK. or, in case of defect, replace with a new unit.
	Broken connection in control circuit.	Look for broken lead on panel and in external potentiometer connections.
	Shorted grid to cathode capacitor on thyratron tubes.	Measure d-c resistance of capacitor. Replace if under 2 megohms.
	Temperature too high for power tubes.	Install sufficient ventilation to cool power tubes.

[Continued on page 132]

plied to the tubes under this condition is above the five per cent allowable.

Adjusting taps are provided on the thyratron filament transformer so the tubes will be provided with the correct voltage, even though the line voltage is as much as ten per cent from nominal. If the line voltage is more than ten per cent below or ten per cent above the rating of the anode transformer, a special transformer will be required to obtain satisfactory operation. (For any particular tap setting, though, the line voltage should not vary more than plus or minus five per cent. If there is any doubt as to the amount of variation, the tap should be set on the high rather than on the low side, as overvoltage will not damage the tubes as quickly as will undervoltage.)

After all interconnections have been made and thoroughly checked, the tubes should be placed in the sockets which bear the same number as the tube. *The anode caps or leads, however, should not be connected to the main power tubes.*

Initial Start

Unless an error has been made in the interconnecting wiring, the tubes will light as soon as the line switch is closed. Different thyratron tubes, depending on whether they are of the mercury vapor type or of an inert gas-filled type, or a combination of the two, require different starting methods. Mercury-filled tubes, in general, require a heating time of about twenty minutes when first installed. The instruction book covering an equipment, however, will give detailed instructions concerning the heating time for the particular tubes used. It is important to follow these instructions, because failure to observe either the initial warm-up time or the required heating time on future starts will greatly shorten the life of the tubes. After the initial warm-up time has elapsed, power should be removed and the anode caps, or leads, should be connected to all tubes.

The disconnecting switch should now be reclosed and the speed adjusting potentiometer on the control station should be set in the minimum speed position. After the normal heating time of the tubes has elapsed, the motor can be started with the "start" push button and the speed can be increased by turning the speed adjusting potentiometer. If the motor fails to operate, or if the control appears abnormal, all push button and motor connections should be thoroughly checked again for errors. Remember that the equipment has been thoroughly tested and operated before it left the factory.

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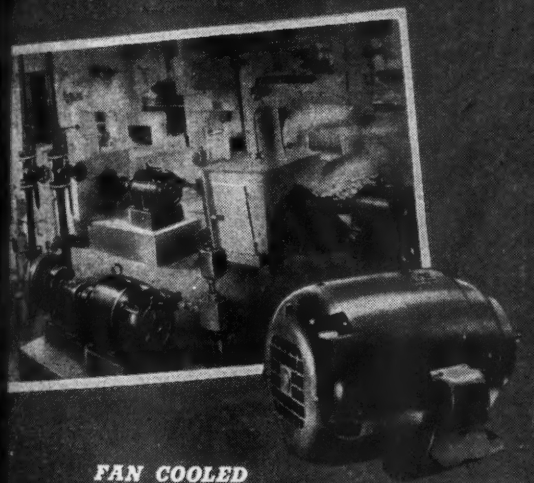

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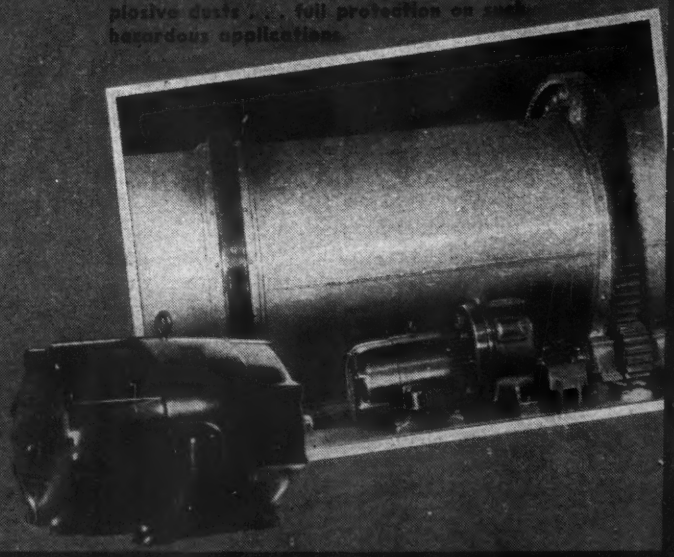

TROUBLE	CAUSE	REMEDY
Speed Erratic.	Dirty relay contact tips.	Clean all contact tips in all except power circuits.
	Defective electronic tube.	Replace all tubes, one at a time, with tubes known to be good.
	Loose connections in control circuit.	Tighten all control terminals and check connections for bad solder joints.
	Temperature too high for power tubes.	Install ventilation for power tubes.
Motor will not run above base speed.	Defective electronic tube.	Replace all tubes, one at a time, with tubes known to be good.
	Open grid transformer or saturable reactor.	Measure d-c resistance of all windings. Replace if open.
	Broken connection in control circuit or potentiometer.	Look for broken lead on panel and in external potentiometer connections.
	Shorted grid to cathode capacitor on thyratron tube.	Replace if d-c resistance is below 2 megohms.
Loss of current or voltage limit or speed regulation.	Defective electronic tube. Broken connection in control circuit or potentiometer.	Same remedies as listed above.
Control panel or anode transformer smokes.	Excessive load or short circuit on transformer.	Check external transformer leads for heating and short circuits. Replace transformer as it has been badly overheated.
	Internal fault in transformer.	Replace transformer.
	Shorted contactor coil or sticky magnet.	Be sure contactor closes firmly. Replace coil.
	Line voltage too high.	Measure line voltage to be sure it agrees with transformer rating. If too high install voltage regulator or obtain special transformer.
Short tube life.	Excessive load.	Measure load with d-c ammeter to be sure it is not greater than panel nameplate.
	Line voltage too high or too low.	Measure voltage to be sure taps on filament transformer agree.

The direction of rotation of the motor, if it is connected in accordance with the interconnection diagram, is, for normal or forward operation, generally counterclockwise when facing the commutator end. The armature leads, A1 and A2, should be reversed if the opposite direction of rotation is required. Where five leads are connected to the panel for reversing operation there is very little chance of error in making this change; but where only three leads are brought to the panel, it is important to be sure that only the two armature leads are actually reversed. If only three leads are brought out of the motor it will be necessary to change the leads internally. Figure 2 shows a three lead motor. To obtain opposite rotation, the lead connecting the commutating and stabilizing field should be broken. Lead A-1 should be connected to the stabilizing field and the open end of the communtating field should be taken to the control panel.

Most panel adjustments are made and sealed in the factory to meet average operating conditions. Because of variations in manufacture of the motor and speed adjusting potentiometer, however, it is not possible to make all the operating adjustments.

Minimum and maximum speed adjustments are usually provided so the speed adjusting potentiometer will cover the speed range required by the motor. The minimum speed adjustment should be made by setting the "speed adjusting potentiometer" in its minimum speed position and adjusting the "minimum speed potentiometer" to give that desired minimum speed. If the control provides adjustable armature voltage, but fixed field voltage, the maximum speed of the motor may be set with the "speed adjusting potentiometer" in its maximum speed position by adjusting the variable resistor usually connected in series with the motor field. The "armature voltage potentiometer" may also be adjusted to obtain small changes in top speed. If the control provides both adjustable armature voltage and adjustable field voltage, the top speed can be set by adjusting the "maximum speed potentiometer." It is important to be sure that the maximum speed set in either case is not higher than the nameplate rating of the motor.

The remainder of the panel adjustments should not be touched if the drive performs satisfactorily. If the drive accelerates too slowly, or perhaps too quickly, the "current limit potentiometer" may be re-adjusted to obtain the desired start. If the speed regulation at low speeds is not correct, the "IR compensation" or "speed regulation" potentiometer may be adjusted to give the required regulation. Panel instruction book should give details.

Preventive Maintenance

Because electronic control has, in general, very few moving parts it does not require the same periodic attention that must be given to rotating or other moving machinery. About the only preventive maintenance that need be given this type of equipment is an occasional inspection to be sure that terminals or leads are not loosening because of vibration, and to be sure that dust, dirt, or oil is not collecting on the panel or auxiliary components. It is well, also, to test the vacuum-type tubes and to visually inspect the thyratrons or other gas-filled tubes to be sure they appear to be firing.

If the speed control potentiometer is continually operating in an automatic cycle, periodic inspection or even replacement of the potentiometer unit should be made.

While the electronic control circuits may appear quite complicated and difficult to service, a large majority of the troubles may be easily located and remedied. The servicing chart includes the troubles most likely to occur. Part II of this article will go into the circuits more in detail and will show simple ways of tracking down more difficult troubles.

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[Continued on page 136]

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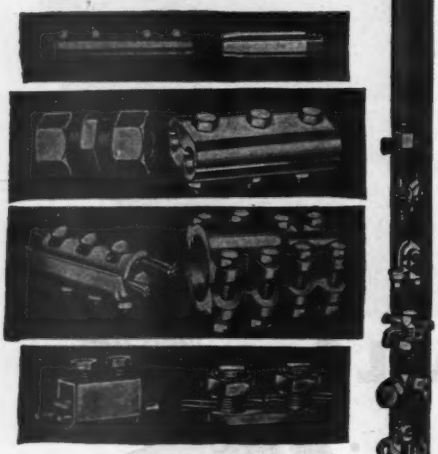
For any good Straight or Parallel *Connector, see the* **COMPLETE** *line*

These illustrations can only suggest the wide variety in the Penn-Union Catalog . . . a *complete* line of Bolted Straight Connectors and Reducers . . . Screw type . . . Split Sleeve type . . . Shrink fit . . . Universal Parallel Clamps . . . E-Z Connectors that take a wide range of conductor sizes.



Also . . . the most complete line of Service Connectors, Tee Connectors, Cable Taps . . . Elbow and Cross Connectors . . . Bus Supports, Clamps, Spacers . . . Grounding Clamps, Terminal Lugs.

Penn-Union connectors are the first choice of leading utilities, industrials, electrical manufacturers and contractors—because they have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.*

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

coating in a wide range of industries. Amercoat Div., American Pile & Construction Co.

CUTTING TOOLS

15 Catalog No. 44 features complete specifications and prices, as well as detailed descriptions of its entire line of adjustable cutting tools. Photos of actual operations and diagrams are given. Robert H. Clark Co.

FUSE PULLERS

16 Bulletin No. 5-A illustrates and describes a tool for removing and replacing fuses, adjusting switch and fuse clips, handling test tubes, etc. Trico Fuse Mfg. Co.

WIRING DEVICES

17 A new 140-page catalog illustrates and describes with specifications and price lists line of conduit fittings, cable terminators, junction boxes, solderless connectors, power connectors and grounding devices. O. Z. Electrical Mfg. Co.

CONDUIT

18 A new 20-page catalog on Orangeburg conduits. It gives data and specifications on Orangeburg standard condiut installations with concrete encasement, and Orangeburg Nocrete conduit for installation without concrete encasement. The Fibre Conduit Co.

FLUORESCENT FIXTURES

19 Catalog No. 281 consists of 12 pages of illustrations and descriptions of a complete new Mitchelite line of all-steel industrial fluorescent fixtures. It also illustrates and explains the new Mitchell aircraft-type "Instant Latch" for release of reflector without use of tools. Mitchell Mfg. Co.

SOLENOIDS

20 A 32-page bulletin on direct-current solenoids, together with tabular data, dimensional drawings, wiring diagrams and response characteristic charts. Cannon Electric Development Co.

ARC WELDING ELECTRODES

21 Bulletin L6348 gives a description of each electrode in this line, also includes separate charts on physical properties of weld metal and recomended current values. Allis-Chalmers Mfg. Co.

RURAL TRANSFORMERS

22 Bulletin No. S-301 illustrates and describes a new line of rural transformers built to ASA and REA specifications. The Standard Transformer Company

RESINS AND PLASTICS

23 A 12-page booklet entitled "Polyethylene Resins" describes the forms, properties, fabrication procedures and uses of this new group of thermoplastic materials. Data tables are included which give graphic summaries of plasticity, electrical properties and thermal expansion. Bakelite Corporation

HEAT TREATING

24 A new job shop service specializing in electronic induction heat treating is covered in a six page folder. Central Boiler and Manufacturing Company

INSTRUMENT TRANSFORMERS

25 A 56-page booklet, GEA-4240, entitled "Instrument Transformer Accuracy Standards". First part explains ASA accuracy standards for potential and current transformers and second part consists of a handy guide for selection. General Electric Company

REDUCTION UNITS

26 A four-page illustrated bulletin describing the new Speedaire fan cooled worm gear reduction units. Cleveland Worm & Gear Company

MASTS AND TOWERS

27 Catalog describing a new line of masts and towers designed principally for radio communication, television and radar. Specifications, construction details and illustrations of each type are given. Harco Steel Construction Co., Inc.

DUCT

28 Bulletin No. 71 features duct for wire and cable distribution systems for light and power. Frank Adam Electric Co.

PLASTIC PROTECTIVE CLOTHING

29 A 16-page catalog describing "Featherweight" and heavy duty protective garments made of solvent-proof transparent plastic called "compar." Resistoflex Corporation

TRANSFORMERS

30 Bulletin B6333 describes an expanded line of subway distribution transformers designed to withstand complete submersion in water. Allis-Chalmers Mfg. Co.

CONTROL EQUIPMENT

31 General catalog No. C-4 illustrates and describes controls for water works, sewage disposal and industrial use. Automatic Control Company

ELECTRICAL EQUIPMENT

32 Bulletin No. CM-1 features stud bases, cable connections, tubing connections, eye-bolt connections, Type SC connection, set screw connections and terminal connector illustrations. Anderson Brass Works, Inc.

INSTRUMENT

33 Bulletin J602-a describes a new instrument called Throttltrol, as a simplified valve positioning device to be used in conjunction with any control instrument having a high and low contact with a neutral position. Wheelco Instruments Company

CAPACITORS

34 Catalog 12—Section J-1 illustrates this line of mica capacitors built to joint Army-Navy specification JAN-C-5. Solar Mfg. Corp.

STORAGE BATTERY WELDING

35 A 12-page illustrated booklet entitled "The How and Why of Storage Battery Welding". It answers questions relating to costs, operation, maintenance, design and installation. Progressive Welder Co.

SELENIUM RECTIFIERS

36 Bulletin RDP-105 contains technical information, specifications, illustrations, wiring diagrams, catalog listings and ordering references on standard selenium rectifiers. Fansteel Metallurgical Corporation

WELDING

37 Bulletin No. 440, consisting of 48 pages, describes the new "Fleet-Welding" method for increasing the speed of welding mild steel. The Lincoln Electric Company

MOTOR PULLEY

38 Catalog HT-44 illustrates and describes the Hi-Torque motor pulleys. It contains dimensions and list prices of standard sizes. The American Pulley Company

INSTRUMENT

39 Bulletin J303-2 describes Rheotrol, a device to maintain a desired electric power or heat input, or flow of liquids or gases to any process or equipment. Wheelco Instruments Company

INFRA-RED

40 Catalog No. 9-644 illustrates and describes the uses and limitations of the near infra-red process. Wabash Appliance Corporation

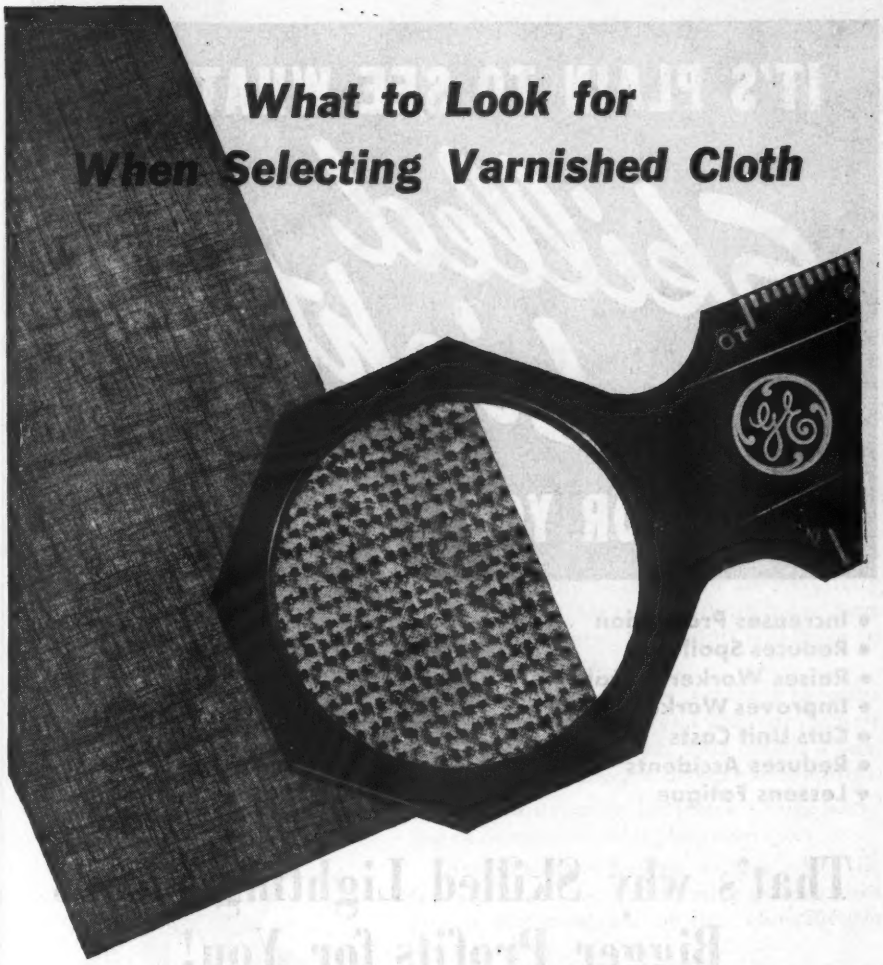
ELECTRIC UNIT HEATERS

41 Bulletin 44-U features the Electromode electric unit heaters for commerical and industrial uses. Tables give dimensions, B.t.u.'s and weights. Electric Air Heater Co.

HAMMER AND DRILL

42 Bulletin 442 describes the "Do-All" combination electric hammer and drill and accessories. It gives prices of tools with different assortments of accessories. Wodack Electric Tool Corporation

[Continued on page 138]



What to Look for When Selecting Varnished Cloth

STARCH VS. VARNISH

The first thing to look for when selecting a varnished cloth is the degree of sizing. The more starch used in the sizing process, the less varnish there will be in the finished product —and it's the varnish that insulates, not the starch. G-E varnished cloth contains minimum sizing and maximum varnish impregnation. Heavy sizing produces a "slick" appearing cloth — one that looks "nice". Minimum sizing helps produce a cloth with high dielectric strength, low power factor, resistance to moisture, excellent heat aging and long shelf life.

DEGREE OF VARNISH HARDNESS

Next consider the varnish—particularly its degree of hardness. The ideal varnish must be soft enough to retain maximum flexibility and to delay stiffening; yet hard enough to withstand abrasion where it may be encountered.

For additional details consult your local G-E Distributor or write: Section RIM-1241-8, Resin and Insulation Materials Division, General Electric Company, Schenectady 5, N. Y.

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 p.m. EWT, NBC. "The World Today" news every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

IT'S PLAIN TO SEE WHAT *Skilled Lighting* DOES FOR YOU:

- Increases Production
- Reduces Spoilage
- Raises Worker Morale
- Improves Workers' Accuracy
- Cuts Unit Costs
- Reduces Accidents
- Lessens Fatigue

That's why Skilled Lighting means Bigger Profits for You!

Sight depends upon proper illumination . . . and so do your profits. For if your workers cannot see effectively, they cannot work efficiently to give you highest production at lowest cost.

To make sure your workers can do their best, why not install Wheeler Reflectors throughout your plant? Product of 63 years of Skilled Lighting, Wheeler units give high-efficiency illumination . . . in a complete line of fluorescent and incandescent fixtures.

Write for Catalog 50. Learn how these engineered units can bring Skilled Lighting – and increased profits – into your production scheme. **Wheeler Reflector Company, 275 Congress Street, Boston 10, Mass.** Also New York. Representatives in principal cities.

All-Steel Open-end Fluorescent Unit

Available for two 40-watt, three 40-watt two 100-watt lamps. Broad wiring channel with easily accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuous runs.

RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

Distributed Exclusively Through Electrical Wholesalers

Wheeler REFLECTOR COMPANY

Lighting Equipment Specialists Since 1881

THERMAL OILERS

43 Bulletin No. 28-A illustrates and describes streamlined thermal oiler with plastic reservoir for solid, wick and waste packed bearings. Trico Fuse Mfg. Co.

FLAT-BELT DRIVE EQUIPMENT

44 Catalog FBD-44, consisting of 24 pages, gives information on steel split pulleys and bushings, shaft collars, shaft hangers and bearings, split and solid conveyor pulleys, Hi-torque motor pulleys, belting and Econ-omatic drives for short-center flat-belt drives. The American Pulley Company

INFRA-RED

45 Bulletin No. 344 gives suggestions for postwar planners and tells step-by-step story of infra-red and how it works on industrial baking, drying, dehydrating and preheating problems. The Fostoria Pressed Steel Corporation

INSTRUMENTS

46 Bulletin J403-2 describes the automatic type Inputrols, electrical timing devices and J402-2 covers the manual type. Wheelco Instruments Company

V-BELT DRIVE

47 Bulletin B6331 illustrates and describes the various V-belts, sheaves and drives. The magic-grip sheave and the four-speed changing methods used are also described. Allis-Chalmers Mfg. Co.

PANELBOARDS

48 A 16-page pamphlet describing a new method of converting obsolete and inadequate electric light and power panelboards to full efficiency without disturbing box or conduit. Square D Company

SEAM WELDER CONTROL

49 Bulletin No. WT-40-41 covers the application, operation, description, specifications and features of these improved electronic seam welder controls. Weltronic Company

INDUSTRIAL FIXTURES

50 Bulletins Nos. F-76 and F-77 describe this line of industrial units and continuous fixtures for two and three 40-watt and two 100-watt fluorescent lamps. Day-Bright Lighting, Inc.

FIRE ALARM SYSTEMS

51 Bulletin No. 1044 illustrates and describes fire alarm signaling systems and apparatus. Schematic diagrams are shown. Faraday Electric Corporation

FUSE MOUNTINGS & DISCONNECTS

52 Bulletin 222-C features the indoor fuse mountings and fused

disconnects for the S & C liquid fuse. Dimensional data for various assemblies are included with details on fuse clips and switch sticks and tongs for handling the fuse. Schweitzer & Conrad, Inc.

ELECTRIC PRODUCTS

53 Condensed catalog No. 441 gives basic information, list prices, dimensions, etc., on safety switches, light and power panelboards, switchboards, circuit breaker panelboards, Kbl-Duct and BUStribution duct. Bull Dog Electric Products Co.

VARIABLE-SPEED TRANSMISSION

54 Bulletin SJ-44 describes speedjack drives. It points out features of drives and provides specifications and installation data. The American Pulley Company.

TRANSFORMERS

55 A bulletin entitled "Standard Transformers for Every Need" describes such types as power, distribution, rural, street lighting, instrument and air cooled transformers. Standard Transformer Co.

DUCT

56 Bulletin No. 427-1 illustrates and describes BUStribution duct of the ventilated low reactance type for feeder circuits up to 2,000 amperes. BullDog Electric Products Co.

WELDING FLUID

57 New engineering bulletin gives results of welding with anti-spatter fluid. It contains laboratory reports on tests for determining weld strength and weld soundness. The Midland Paint and Varnish Co.

THERMAL CONTROL

58 A 44-page catalog illustrating and describing Thermoswitches for temperature regulation. It includes installation drawings and photographs for both temperature and pressure control apparatus. Fenwal Incorporated.

HOSPITAL SIGNAL SYSTEMS

59 Bulletin No. 1045 features signal and communication systems for the hosiptal and nurses' home. Faraday Electric Corporation

GERMICIDAL UNITS

60 Catalog 544 describing Disinfectaire ultra-violet germicidal units, for the disinfection of air in hospitals. Art Metal Company

HEAT CONTROLS

61 Bulletin No. WTH-44 contains descriptions, applications, specifications and features of this improved line of "package unit" heat controls, which provide dial-controlled infinitely variable phase-shift regulation of welding current. Weltronic Company

[Continued on page 140]

2,000,000
New Customers
WAITING FOR
SERVICE
● A recent survey indicated that 2,000,000 rural homes not wired could use electricity to advantage. Of these, 400,000 are near existing lines and 1,600,000 will have to be served by new lines.
The building industry is talking in terms of 1,000,000 new homes a year for the first five years after the war. This means a vast increase in line load in urban communities.
This construction indicates a huge backlog of demand for telephone service.
Discount these figures as you will—the fact remains that public utility companies face a big program of line construction after the war.
Klein tools and equipment will be ready for the linemen and electricians working on this expansion program. The Klein line of tomorrow will continue to offer the same high quality—the same regard for safety that has characterized all equipment carrying the name Klein "since 1857."
ASK YOUR SUPPLIER
Foreign Distributor:
International Standard Electric Corporation, New York
This book on the care and safe use of tools will be sent without charge upon request.
LONG LIFE TO TOOLS
KLEIN
Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
3200 BELMONT AVENUE CHICAGO '18 ILLINOIS

● Aerovox introduced the high-capacity electrolytic capacitor for motor-starting. Aerovox has supplied the major portion of such capacitors in daily use. And now Aerovox helps you service those wornout motor-starting capacitors and keep old refrigerators running for the duration at least, with Aerovox "Victory" replacements.

The Victory line consists of 28 universal numbers. 22 for 110-volt, 6 for 220-volt. These numbers take care of upwards of 90% of all motor-starting replacements. Handy Aerovox conversion chart indicates "Victory" equivalent for any previously available type. Minimum stock. Maximum service.

● Ask Your Jobber...

Ask for Aerovox "Victory" motor-starting capacitor replacements. Select the units you need from the Aerovox conversion chart. Or write us direct.

AEROVOX Capacitors
INDIVIDUALLY TESTED
AEROVOX CORP. NEW BEDFORD, MASS. U.S.A.
In Canada: AEROVOX CANADA LTD. HAMILTON, ONT.
Export: 13 E. 40th St., N.Y.C. 16, N.Y. Cable: ARLAB

DISCONNECTING SWITCHES

62 Publication No. 4401 describes two to five thousand amperes, single pole, single throw, stick operated, straight current path, front connected indoor disconnecting switches. Delta-Star Electric Company

ADHESIVE DATA

63 A new booklet entitled "3-M Adhesive Data" gives data on adhesives or coating materials, impregnators, spray-on insulation and sound-deadening compounds. Minnesota Mining and Manufacturing Company

SPOT WELDER

64 A 58-page catalog No. CE-44W, entitled "Spot Welders", shows all types of standard and special resistance welding machines in this line. Eisler Engineering Co.

LUBRICATION

65 An illustrated bulletin entitled "Aloft is no Place for A.W.O.L. (absent without lubrication) Bearings", explains the application of the Farval Dualine systems for sending lubricant under pressure from a central pumping unit to every bearing on the machine. The Farval Corporation

FOUNDRY OVENS

66 Bulletin 32 features an improved line of coremaster drawer-type ovens for the large and small foundry and lists models available with gas, oil or electric heating systems. Despatch Oven Company.

ELECTRONIC SUPPLIES

67 Monthly industrial availability booklet shows items available on priority for immediate delivery from stock. It lists such items as tubes, test equipment, industrial sound systems, timers, relays, constant voltage transformers, condensers, industrial switches, fluorescent lamps, plastic wiring systems, electric drills, saws, grinders and other tools. Walker-Jimieson, Inc.

ALTERNATORS

68 Aviation accessory design check chart No. 10 features alternators for a-c or d-c power supply systems. Eclipse-Pioneer, Division of Bendix Aviation Corporation, Teterboro, N. J.

POWER PLANTS & GENERATORS

69 Bulletin 1044 illustrates and describes a-c and d-c power plants, frequency changers, battery chargers, a-c and d-c generators, motor generators and rotary converters. Kato Engineering Company

VIBRATION CONTROL

70 A folder describing vibration control, an effective aid to production, reduced maintenance, and building protection. Vibration Control Co.

How to save time by doing more reading

That is a profitable paradox for you. More true today than perhaps ever before. For here in the pages of this publication are packed many helpful ideas . . . considerable useful information. Much of it, in fact, available from no other source.

And we most emphatically mean *both* the editorial and the advertising pages.

Just one new idea gleaned from these pages . . . a method for doing something better or faster or easier or at lower cost, may alone save you far more than a year's reading-hours invested in this and other worthwhile business papers.

Many people have found this a fact . . . not only once, but time and time again. That's significant . . . with time so precious today.

Good advertising speeds information from those who have it . . . to those who need it.

★

McGraw-Hill Publishing Company, Inc.

330 West 42nd Street
New York 18, N. Y.

Not Time Yet for Paper Capers!

Sure, the news is good — terrific, in fact. But don't let that give you the idea that America's paper shortage is over. More paper than ever is needed now to wrap supplies for our armies as they drive toward their goal. There's still a manpower shortage in the pulp industry.

So, you've still got to watch your company's use of paper with the hawk eye of a paper miser.

You've still got to use your ingenuity and that of your staff to find even more ways to *use less paper.*

All material made of paper and paperboard still must be cut to the bone. Eliminate whatever you can until complete and final victory ends the paper pinch.

The baling of wastepaper and sending it to the reprocessing plant is still of prime importance.

Remember—
PAPER IS WAR POWER

USE LESS PAPER—SAVE ALL WASTEPAPER

This advertisement contributed by this publication and prepared by the War Advertising Council in cooperation with the War Production Board and the Office of War Information.

IN THE NEWS

WPB REVOKES ORDER L-225

The War Production Board has revoked Order L-225, which controlled the manufacture and sale of electrical conduit, electrical metallic tubing and raceways. The type of steel used in the manufacture of this equipment, chiefly small sizes of Bessemer tubular steel, is no longer in short supply and further control is unnecessary, WPB said.

The order, originally issued in December, 1942, to conserve steel, limited the amount of metal that could be used by manufacturers to a percentage of the amount used in 1941; permitted sales only on rated orders and restricted installations to specified end uses. Restrictions on installations were removed by an amendment to the order issued on October 6, 1944.

Manufacturers and distributors, formerly permitted to sell conduit tubing and raceways only on reference ratings of AA-5 or better, may now make unrestricted sales as a result of the revocation of L-225. Production is expected to increase somewhat, WPB officials said.

NISA ADOPTS REGIONAL DIVISIONS

At a recent meeting of the Board of Directors of the National Industrial Service Association in Miami, Florida, a procedure was set up for the election of Directors. At the Cincinnati conference this spring, NISA By-Laws were amended to provide for an enlarged Board of Directors.

The new Board will consist of 15 Directors and will meet directly after the next annual convention. Officers for the ensuing year will be elected from among the Board members and an Executive Committee of seven members will function in active direction of the Association affairs. Under the new system a Director's term of office will be three years, with one-third of the Board being elected each year. This will become effective after an interval of time required to adjust the terms on a rotating basis.

The Board adopted a proposal of the Resolutions Committee (W. H. Wheeler, F. W. Willey, E. C. W. Johnson) to divide the country into the following regions for the purpose of electing Directors.

Region 1—Maine, Vt., N. H., Mass., R. I. and Conn.

Region 2—New York and New Jersey.

Region 3—Pa., Del., Md. and District of Columbia.

Region 4—Va., No. Car. and So. Car.

Region 5—Georgia and Florida.

Region 6—Tenn., Ala., Miss. and La.

Region 7—Ohio, W. Va., and Ky.

Region 8—Michigan and Indiana.

Region 9—Wisconsin and Illinois.

Region 10—Minn., No. Dak. and So. Dak.

Region 11—Iowa and Nebraska.

Region 12—Okla., Mo., Ark. and Kans.

Region 13—Tex., N. Mex., Ariz., Colo., Wyo. and Utah.

Region 14—Mont., Nev., Ida., Wash., Oregon and Calif.

Region 15—Canada.

The election procedure, as decided by the Board, provides that during the first week in January the Executive Secretary is to mail each member in good standing a nomination ballot. These ballots are to be returned at once with the names of candidates from the members' region. From the nominations received the three candidates having the largest number of votes become the nominees. These names are mailed out on election ballots on Feb. 15 to the regions balloting. March 1 is the deadline for return of the letter-ballots so the new Directors from each region can be determined before the annual convention.

To set up the rotating character of the Board, *this year only*, the election for a three-year Director will be held in Regions 3, 6, 9, 12 and 15. A two-year Director will be elected in Regions 2, 5, 8, 11 and 14. One-year term Directors will be chosen in Regions 1, 4, 7, 10 and 13.

WPB ESTABLISHING CONSTRUCTION BUREAU

J. A. Krug, Chairman of the War Production Board, has announced that, in order to provide a centralized point of control over all matters pertaining to construction within WPB, a Construction Bureau is being established, responsible to Hiland G. Batcheller, Operations Vice

"I'm afraid you didn't understand when I mentioned splicing, Miss Devere!"

Chairman. The bureau will be headed by Arthur J. McComb, of Montclair, N. J., who has been serving as director of the Office of Industry Advisory Committees.

The Construction Bureau will include the existing Building Materials Division, the Construction Machinery Division, the Plumbing and Heating Division and the bulk of the Facilities Bureau, which is being abolished.

A Bureau Requirements Committee is being established to pass on all construction requirements and construction programs and all major construction projects. It will also review the requirements of the divisional requirements committees of the component divisions of the Construction Bureau. Appeals from its determinations will be taken only to the central Requirements Committee of WPB.

Mr. Krug pointed out that establishment of this bureau not only provides a centralized point of control for the handling by WPB's operating divisions of all problems in the construction field, but also furnishes a mechanism through which construction work can be actively promoted whenever diminishing war requirements make that possible.

Under the new set-up, a manufacturer or a contractor who seeks approval for a building project will go to the WPB operating division that has jurisdiction over his field, just as he would have done in the past. The Construction Bureau will not eliminate the responsibility of these divisions and their respective requirements committees for sponsorship of such projects, but it will provide a means through which the prospective builder can have all of his problems handled in one place, so that it will not be necessary for him to deal with a number of separate WPB divisions.

The Facilities Committee will be abolished as soon as the Bureau Requirements Committee is in full operation, WPB said. The Materials Control Division, the Project Analysis Branch and the Tax Amortization Branch of the Facilities Bureau's Project Essentiality Division are being transferred to the Construction Bureau.

INADEQUATE INSTALLATIONS *postwar I.A.E.I. Committee Report is given final review by Roger B. Kellogg (left) Commonwealth Edison Co., Chicago; and J. Hyde Stayner, Utah Power & Light Co., Salt Lake City, chairman, before presentation to the Western section, I.A.E.I. conference.*

WE "BENT" LIGHT IN *Eight* DIRECTIONS

to illuminate shelves and bins

The Stocklite is finished in permanent porcelain enamel; easy to clean, to maintain full reflective efficiency.

By scientifically "bending" light in 8 directions, the Stocklite does what no other fixture has ever accomplished to provide proper illumination of shelves and bins in narrow stockroom aisles. That's what makes it one of the most remarkable and efficient reflectors in the entire lighting industry.

Moreover, this busy little reflector doesn't waste light *anywhere.* The lamp's full intensity is utilized. Aisle glare is eliminated by curved V-shaped flanges, which direct light to the sides—building up intensities from top to bottom shelf and in bin interiors—where it's needed.

Today, wherever the Stocklite is used, you'll find stock clerks reading comfortably anywhere in the aisles. You'll find orders being handled more easily, more expeditiously and with fewer mistakes. The Goodrich Stocklite is modernizing stockroom illumination everywhere. Get the facts about it *now.* Write for Bulletin 91.

Sold through electrical wholesalers.

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

McGRAW AWARD TO LATE CARL M. SNYDER

The Committee of Awards for the James H. McGraw Award for Electrical Men voted the Medal for Cooperation for 1944 to the late Carl M. Snyder, which together with the purse was presented to his widow, Mrs. Snyder, by S. B. Williams, secretary of the Committee of Awards and editor of *Electrical World*, at a dinner given by the General Electric Co. at New York City on November 28.

The posthumous award was made to Mr. Snyder in recognition of his contribution to improved standards of living for the American people through a concept for functionalizing kitchens and homes around electrical devices and bringing his ideas into wide public acceptance through the collective action of members of all of the building and electrical industries.

The judges were H. C. Thuerk, president, New Jersey Power & Light Company, Dover, N. J.; John M. Newton, president, Oakes Electrical Supply Co., Holyoke, Mass.; W. J. Wheeler, president, The Maintennace Company, New York; A. D. Cameron, vice-president, Holophane Company, New York and S. B. Williams, secretary, Committee of Awards.

The citation reads as follows:

"Though forever unknown to those who will benefit most from his constant endeavor to improve the American standard of living through better planned homes

CARL M. SNYDER

who departed this life on August 14. 1943, has left to them, the millions who will live in post-war houses in this country, a heritage richer than money. An architect by profession, he saw in the electrical appliance a tool with which to fashion American homes on the basis of efficiency and convenience. This functionalized approach made its start in the electric kitchen

CARL M. SNYDER

to the planning of which Mr. Snyder brought the cooperation of architects, engineers, manufacturers of various kinds of building materials, dealers and utilities. His vision was never narrow but had the qualities of business statesmanship combined with the personal charm, enthusiasm and earnestness needed to inspire a following regardless of business or industry affiliations. Although employed by one manufacturer he saw the fulfillment of his plans only in the collective action of all who had an interest in modernizing the American kitchen.

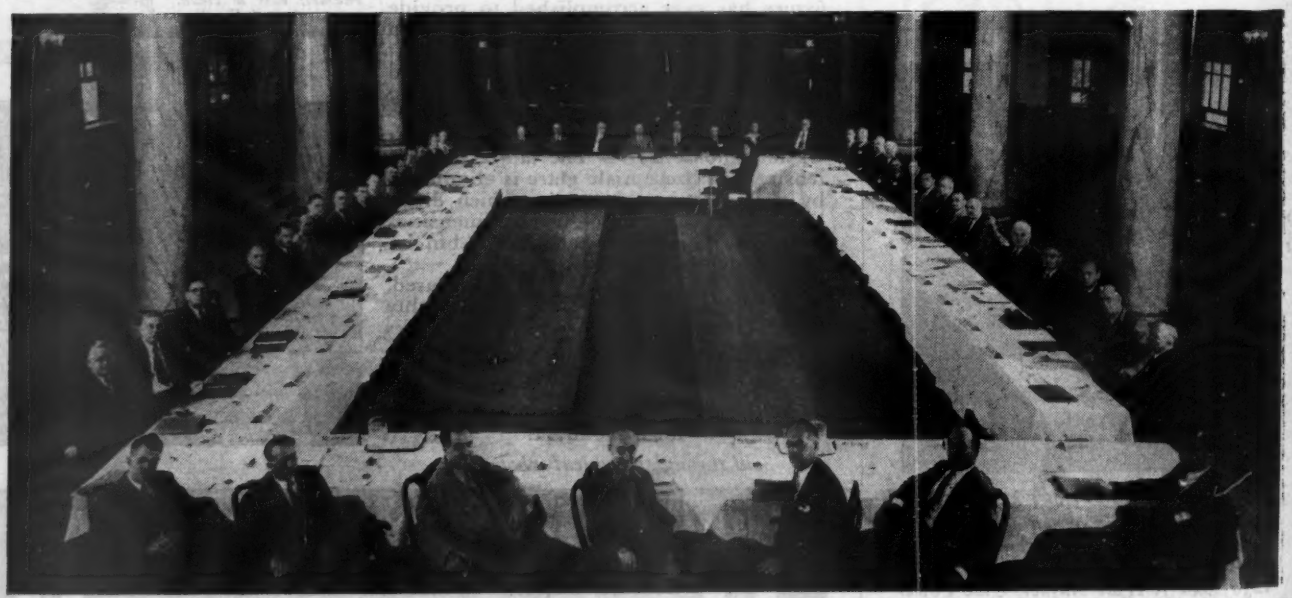
"While employed in this work by the General Electric Company he expanded this program for cooperation between the several elements of the electrical and building industries to embrace the entire home from which came the General Electric's Home Bureau, which he founded in 1936, and the architectural contest which produced the 'New American' home plans that were to have such profound effect upon residence design. Long before he came into the electrical industry, the all-electric home was being shown to thousands of people as a model house furnished with electrical devices but the concept of designing a home functionally around such devices, the principle of which would meet with wide public acceptance, remained for Mr. Snyder to accomplish.

"For this contribution to improved standards of living for the American people as well as to the advancement of the electrical industry through collective action, the Committee of Awards have voted to Carl M. Snyder, as a posthumous award, the 1944 Medal for Cooperation and to Mrs. Snyder the purse under the James H. McGraw Award."

HOME PLANNING INSTITUTE IDEA GROWS IN CALIFORNIA

Originated in the electrical industry and sparked into activity through the agency of the Pacific Coast Electrical Association, the Home Planning Institute is now in full swing in California. Institute meetings have been held in 17 southern California cities since the inception of the movement late last year, while at least eight others have been completed or are now in progress in northern California, included in the 18 or 20 planned for that area in the immediate future.

Two main objectives of the Institute lecture courses are: (1) To encourage immediate action, as soon as materials are available, on the part of people expecting to build homes, instead of waiting for an indefinite period in order to try to embody in their homes everything of a spectacular and frequently a speculative nature that they have been hearing about as constituting the dream home of the future. (2) To help the builder to "budget his thinking" and within the limits of his purse segregate his requirements into



FIRST MEETING of the new members of the Board of Governors of the National Electrical Contractors Association was held at French Lick during the annual meeting of NECA.

three classes; namely, (a) those things absolutely essential to his needs, (b) those that are desirable but which can be added later, and (c) those that he must forego as sheer luxuries beyond his budget.

Through the cooperation of the various trade associations interested in home building or home rehabilitation, a lecture course has been prepared which has been sponsored by the Adult Education Department of the public schools and open to the public free of charge. Qualified lecturers are supplied by the trade associations, covering such varied subjects as selection of site, description of materials, electrical and plumbing installations, color in the home, financing and many other related subjects.

Experience has indicated that the series can be covered in ten 2-hour sessions, two subjects at each session. The attached outline of program can be obtained in any community of the state by contacting V. W. Hartley, managing director of the Pacific Coast Electrical Association; Walter R. Hagedohm, public relations chairman State Association of California Architects or Neill Davis, Building and Loan League, all of Los Angeles. These men act as a clearing house for speakers and render every service possible in expediting home planning institutes in any city desiring them. The boiled-down program, comprising twenty lectures follows: (1) Why Plan Now? (2) Contemporary Homes. (3) Site Selection. The first three conducted by a representative of the State Association of California Architects. (4) Building Laws, by a representative of the building department of the city where held. (5) You Design your Home and (6) Work Spaces, Service Areas and Storage Space, by representative of the S.A.C.A. (7) Heating and Ventilating, representative American Society of Heating and Ventilating Engineers. (8) Insulation, representative A.S.H.V.E. (9) Color in your Home, representative S.A.C.A. (10) Color in Interior Decoration, by representative of that profession. (11) Lighting and (12) Adequate Wiring, Representative Pacific Coast Electrical Association. (13) and (14) Plumbing, representative Merchant Plumbers Association. (15) and (16) The "Makings" of Your Home, representative Building Contractors Association of California. (17) Budgeting Your Home, representative of the Federal Housing Administration. (18) Arranging Your Financing, representative California Bankers Association or California Savings and Loan League. (19) Protecting Your Investment, representatives California Savings and Loan League and California Land Title Association. (20) Assembling Your Ideas. Representative S.A.C.A.

All programs are put on in the school auditoriums of the cities, sponsored by the school authorities and conducted by the faculty members. No direct commercialism, no trade names or brand characteristics enter. How best to get the activity under way in each community is determined by local conditions. The first step, however, is to appoint a steering committee of six to 12 men to organize locally, raise the necessary funds, etc. If there is a Chamber of Commerce, it is of course a

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BOXES FURNISHED WITH OR WITHOUT CLAMPS

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The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one ½ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

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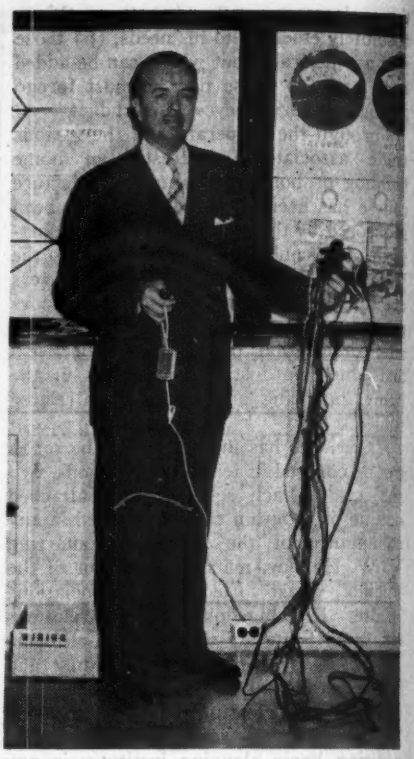

A. B. SMEDLEY lectures on adequate wiring at California Home Planning Institute. He explains that the home of the future should have heavier copper so that full advantage may be taken of more and new applications of electric current as they come along.

great help. The school superintendent becomes Program Chairman. The leading newspaper editor becomes Advertising and Publicity Chairman.

A meeting is then called of everyone in the community whose business is related to home building and furnishing, including financing agencies. Money is raised through direct subscription from these interests and local advertising arranged for. Details of the organization routine, which would be helpful to those in other areas who are interested, will be furnished by Mr. V. W. Hartley and will be sent on request. His address is 1223 Edison Building, Los Angeles.

From the electrical contractors' standpoint, there are two features of the program of major interest—(11) and (12). Modern lighting will be required, not only to eliminate glare but in quantity and quality to make for more comfortable living. This has a decided decorative value, also, which is cleverly brought out in the demonstration. Adequate wiring, one of the most important hidden values in the home, is emphasized by another set of demonstrations, so that the prospective builder knows what he should have in that line before he starts building, rather than waking up to what he has missed after it is too late.

The lectures on lighting in the southern California area are given by R. E. Buckby while W. L. Stickel and A. B. Smedley in the southern area and J. A. Hill in the northern handle the wiring. They put on really convincing demonstrations as indicated by the photographs.

In presenting this plan recently before the Ninth Annual Conference of Inter-

national Association of Electrical Leagues, in Detroit, Mr. Hartley concluded with these remarks:

"When wartime restrictions are lifted, there is going to be a mad scramble for the consumer's dollar. There will be only two avenues of procedure to follow: —wild, cut-throat competition, from which no one profits—the customer least of all; or an orderly, coordinated program in which all factors cooperate. This latter course is not only good business but means better homes; and that is the best investment that can be made in the future welfare of America."

ROCKY MOUNTAIN LEAGUE ELECTS '45 OFFICERS

Following the traditional custom of having a different state supply presidential material each year, Arthur Prager, Albuquerque Gas & Electric Co., New Mexico, was chosen to head the Rocky Mountain Electrical League (Colorado, New Mexico, Wyoming, South Dakota) for the coming year. However, upon Mr. Prager's announcement of his inability to accept the honor F. F. McCammon, vice-president and supt. of electric operations, Public Service Company of Colorado, was elected to pilot the organization.

Assisting Mr. McCammon in the administration of League affiairs will be the following elected vice-presidents: W. D. Johnston, Mountain States Power Co., Casper, Wyoming; E. T. Tengdin, Inland Utilities Company, Espanola, New Mexico; L. R. Storey, Home Gas & Electric Co., Greeley, Colo.; Ross H. Adams, Hendrie & Bolthoff Mfg. Co., Denver. W. C. Sterne, president of Arvada Electric Company was re-elected treasurer and Harry Adler of the same firm, assistant treasurer.

Heading up the major League Divisions are the following:

Contractors—Ralph E. Johnson, Sturgeon Electric Co., Denver, Colo.

Sales and Promotion—H. T. Rankin, Public Service Co. of Colorado, Denver.

Dealer Cooperation—Ray Jones, Ray Jones Washing Machine Co., Denver.

Engineering—Lloyd W. Edwards, Mountain States Power Co., Casper, Wyo.

Accounting—W. D. Virtue, Public Service Co. of Colorado, Denver.

Utilities—K. W. Kissick, Trinidad Electric Transmission Railway & Gas Co., Trinidad.

Manufacturers—A. S. Anderson, General Electric Co., Denver.

Distributors—E. L. Garihan, Mine & Smelter Supply Co., Denver.

Postwar Planning—C. C. Baker.

MAYER REJOINS HYLAND ELECTRIC

Leo E. Mayer, past president, NECA, and former chief purchasing agent for the Livingston-Dearborn-White City joint venture group on the Dodge Chicago plant

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Type		Poles	Switch Capacity	Case
M1	(Synchonous)	1	50 A. at 125 V.	16 Ga. Steel
M2	"	2	50 A. at 125/250 V.	16 Ga. Steel
RM	"	1	50 A. at 125 V.	Cast Iron
RM5	"	2	50 A. at 125/250 V.	Cast Iron

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job has again taken up his duties as manager of contractor sales for the Hyland Electrical Supply Company, Chicago, according to an announcement by Chas. H. Weicensang, vice-president of Hyland.

Mr. Mayer was on a leave of absence from the Hyland firm for the past two and one-half years to take over the purchasing job on the 10 million dollar electrical installation now in its last stages at the above mentioned project.

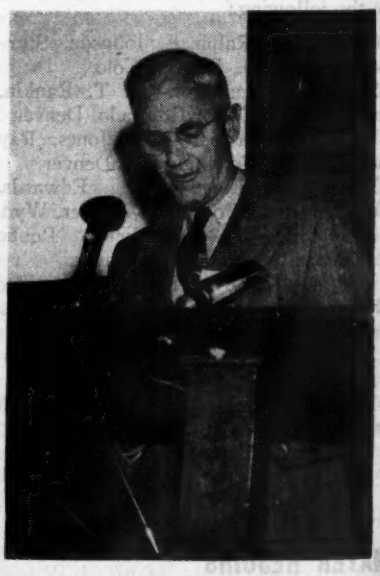
WPB 1319 REQUIRED FOR DOMESTIC WATTHOUR METERS

General Limitation Order L-151 covering domestic watthour meters has been amended by the War Production Board. No person shall deliver or accept delivery of any new domestic watthour meter unless it is a delivery:

(1) To or for the account of the Army, Navy, Maritime Commission, War Shipping Administration or Veterans' Administration.

(2) Between persons who own or operate electric power utilities which serve the public generally.

(3) Authorized by the War Production Board on Form WPB-1319. Any prospective purchaser may apply for such an authorization by filing Form WPB-1319 in accordance with the current instructions for filing such forms. These form applications should be filed with the nearest Regional Office of the War Production Board. As a general rule, favorable consideration will be given applications for permission to purchase new domestic watthour meters only where the meters are required for the extension of service to new customers or are required for the replacement of meters destroyed in service or damaged beyond repair.



R. C. LOUGHEAD, chairman of the Technical Subcommittee on Infra-red Lamp Industrial Heating Equipment, Electrical Committee, N.F.P.A., presents the committee's recommendations to the Western Section, I.A.F.I. conference in Indianapolis.

REWIRING PROBLEMS in old houses are swapped back and forth by L. S. Crain (left), chief electrical inspector of Lincoln, Nebraska and Bill Boon, chief electrical inspector of Topeka, Kansas, at Indianapolis meeting of Western Section, I.A.E.I.

CMPR NO. 5A AMENDED

Governmental agencies and institutions will be able to obtain minor capital additions costing up to $500 under the provisions of Controlled Materials Plan Regulation 5A as recently amended, the War Production Board announced through the Office of Civilian Requirements' Government Bureau.

The limit previously has been $100. Liberalization of the order, accomplished by amending Paragraph (b) (6) and corresponding paragraphs in Interpretations 5, 6 and 7, puts the agencies and institutions that use CMP 5A on the same basis as businesses and industries that have been operating under CMP 5 insofar as this provision is concerned, WPB said.

CMPR NO. 6 MODIFIED

Modifications in the Construction Limitations applicable to certain authorized building projects, which reflect recent changes in War Production Board orders governing materials used in construction, have been made in Schedule A to Controlled Materials Plan Regulation No. 6. Former restrictions on electrical installations have been changed to a single prohibition against installation of wire and conduit of larger sizes than the minimum required by the 1940 National Electric Code.

The revised restrictions are applicable to all construction authorized on Form GA-1456 whenever issued. A builder who has received such an authorization may follow either the new or the old restrictions. The changes also apply to certain utility construction controlled by WPB Order U-1 (Utilities). They do not, however, apply to housing construction authorized by the National Housing

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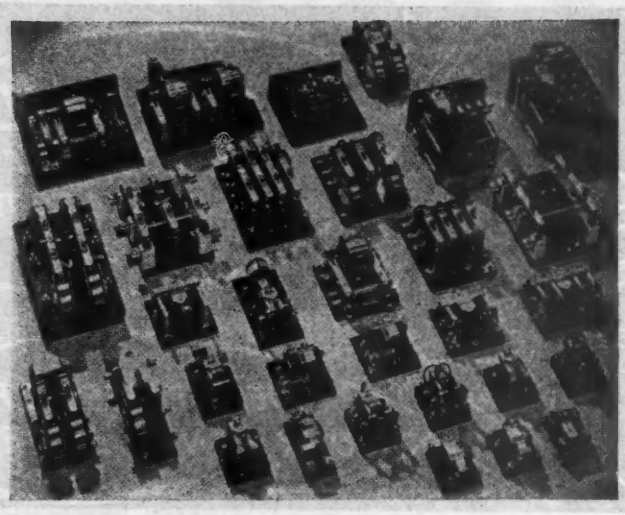

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These Bulletins are available describing light, intermediate and heavy duty relays in various types and contact combinations. Send for the data bulletins of interest.

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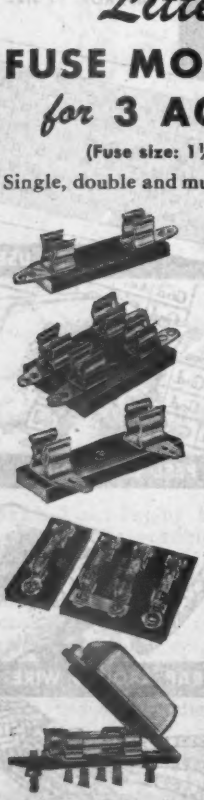

Open Type Single Pole Mounting No. 351001 (Old No. 1060). Black bakelite base. Overall length, 2½". Shakeproof terminals. One mounting hole.

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Universal Fuse Panel No. 1505 Series. Standardized units for 10 fuse sizes, any practicable number of poles. Send for blueprints.

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Agency. Such housing is subject to Limited Preference Rating Order P-55-c, and not to Schedule A of CMP Regulation 6, WPB pointed out.

Form GA-1456 is used to authorize most commercial, industrial and agricultural construction controlled by Conservation Order L-41, the basic construction order. Other forms are used for housing construction approved by NHA, for certain Army and Navy construction and for a few other specialized kinds of construction.

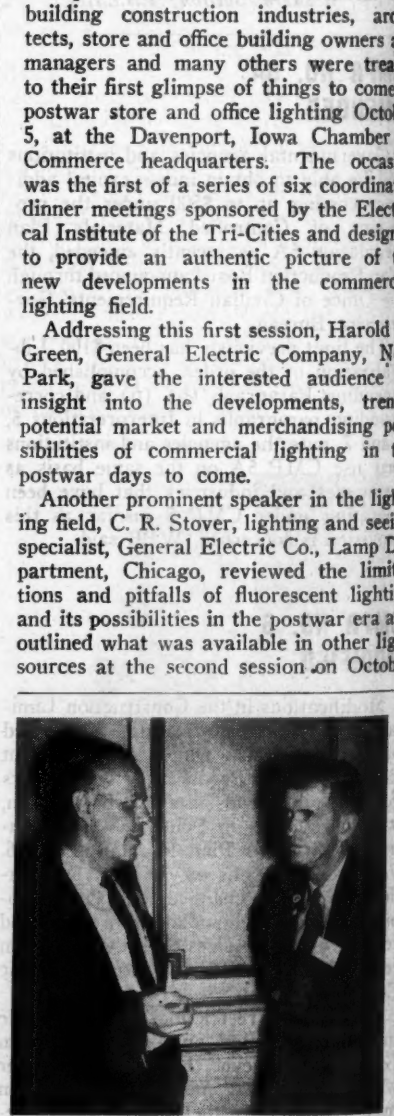
The amended schedule permits builders to use the following materials or products formerly prohibited or restricted: Steel plate, aluminum, metal lath, certain building components such as hardware, plumbing and heating items, and certain other items manufactured from steel sheet or strip, or from copper.

TRI-CITY REVIEWS POSTWAR COMMERCIAL LIGHTING

Representatives of the electrical and building construction industries, architects, store and office building owners and managers and many others were treated to their first glimpse of things to come in postwar store and office lighting October 5, at the Davenport, Iowa Chamber of Commerce headquarters. The occasion was the first of a series of six coordinated dinner meetings sponsored by the Electrical Institute of the Tri-Cities and designed to provide an authentic picture of the new developments in the commercial lighting field.

Addressing this first session, Harold H. Green, General Electric Company, Nela Park, gave the interested audience an insight into the developments, trends, potential market and merchandising possibilities of commercial lighting in the postwar days to come.

Another prominent speaker in the lighting field, C. R. Stover, lighting and seeing specialist, General Electric Co., Lamp Department, Chicago, reviewed the limitations and pitfalls of fluorescent lighting and its possibilities in the postwar era and outlined what was available in other light sources at the second session on October



ELECTRICAL INSPECTIONS for the Municipal Light & Power Company, Anderson, Indiana, are under the jurisdiction of chief inspector Wm. R. Reynolds (left) and his assistant Carl Lucas.

NEW I.E.S. PRESIDENT, S. B. Williams (right), editor, ELECTRICAL WORLD, and retiring president Howard M. Sharp, Buffalo, Niagara & Eastern Power Co., discuss activities of the Illuminating Engineering Society at its recent technical session in Chicago.

19, at the Iowa-Illinois Gas & Electric Company headquarters in Rock Island, Ill.

The rest of the series, alternating between the two cities mentioned featured additional nationally prominent lighting specialists as outlined by the following program:

Merchandising With Light—a development of the three "A's" of lighting —Atmosphere, Attraction, Appraisal— with emphasis on general show case feature lighting. Speaker: J. M. Ketch, illuminating engineer, General Electric Co., Nela Park.

How to Put Light Where Needed —a discussion of quantity, quality, control and distribution of light, embracing latest fixture developments. Speaker: A. W. Larson, Westinghouse, Cleveland.

Architectural Aspects of Lighting for Profit Tomorrow—new lighting techniques to glorify surroundings, dramatize merchandise and step up profits. Speaker: K. C. Welch, vice-president, Grand Rapids Store Equipment Co., Grand Rapids, Mich.

Putting the New Lighting Technique to Work—a review of the application, specification and design of better lighting for greater profits. Speaker: L. V. James, lighting and seeing specialist, General Electric Co., Lamp Department, Chicago.

NEW EXECUTIVE ORDERS 9490 AND 9491

Chairman J. A. Krug of the War Production Board has announced measures adopted by WPB to implement two new Executive Orders (9490 and 9491) affecting war facilities financed under Section 124 of the Internal Revenue Code.

Section 124 allows taxpayers to write off the cost of necessary facilities over a five-year period (or less should the emergency end sooner) instead of over the longer depreciation period normally used for tax purposes.

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4. Champion Distribution — through competent industrial suppliers equipped to meet your needs promptly and effectively.
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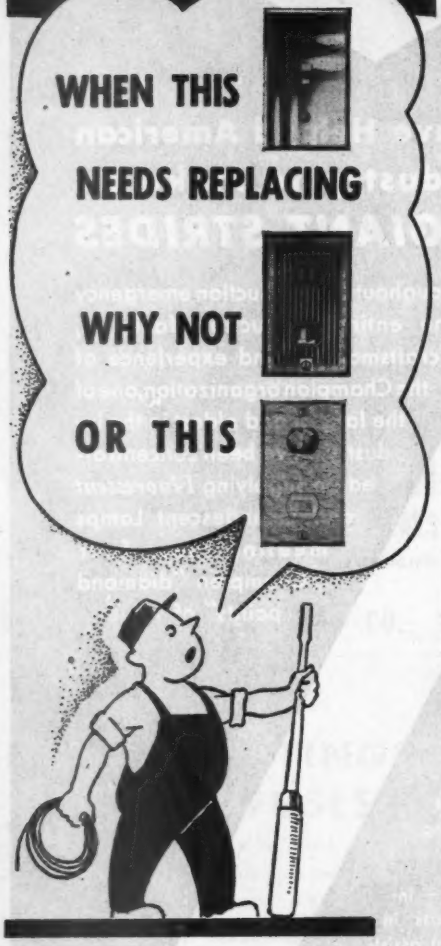

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The new Executive orders authorize WPB to amend "Necessity Certificates" originally issued by the Army and Navy and to issue so-called "Payment Certificates."

Amendments to Necessity Certificates merely correct descriptions of facilities and set forth their actual cost in cases where the original certificates were issued on an estimated basis.

The Payment Certificate is authorized where a payment has been made by the Government for the unamortized cost of an emergency facility because a contract has been terminated. The effect of these certificates is to make such payments tax-free.

AMENDMENT NO. 55 TO REVISED SUPPLEMENTARY REG. NO. 11

Four types of services on equipment used for the detection of, and protection against, fire, theft, burglary and sabotage in certain buildings have been exempted from price control by the Office of Price Administration.

The four services exempted, effective November 11, 1944, are maintenance, supervision, operation and inspection of this equipment. The services of installing, renting or repairing the equipment are not included in the exemption.

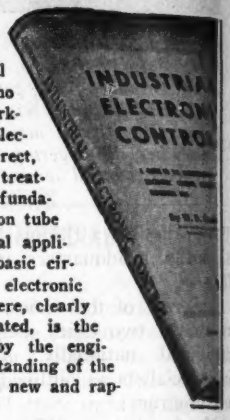
The certain buildings in which the equipment must be located to qualify the four specified services for exemption are buildings not used for operations dealing with a commodity. Such buildings would include schools, hospitals, etc.

If the equipment is in buildings where such operations as production, processing, distribution, storage or sales of a commodity are performed, the exemption does not apply and the four services remain under ceilings established in the services regulation. These buildings would include plants, warehouses, shops, office buildings, etc.

This action conforms to a decision of the Emergency Court of Appeals in the case of the Automatic Fire Alarm Com-

PRACTICAL and theoretical sides of industrial plant electrical distribution are aired at A.I.E.E. summer technical session by (L to R) S. L. Coulter, construction superintendent, Albert Kahn, Inc.; and Otto Meier, Jr., professor of electrical engineering, Duke University

Facts You Need—
for selling
installing
and servicing
electronic
equipment



This is the first book written especially for the practical electrical man in industry who desires a basic working knowledge of electronic control. In a direct, non-mathematical treatment, it gives you fundamental facts of electron tube operation and practical applications of tubes in basic circuits of industrial electronic control apparatus. Here, clearly explained and illustrated, is the information needed by the engineer for quick understanding of the special aspects of this new and rapidly growing field.

INDUSTRIAL ELECTRONIC CONTROL

A Guide to the Understanding of Electronic Control Circuits for Industrial Use

By W. D. COCKRELL

Industrial Engineering Divisions, General Electric Co.

247 pages, 5½ x 8½, 175 illustrations, charts, and tables, $2.50

The book emphasizes the fundamental functions and basic circuits important to an understanding of any control circuit and illustrates them by standard commercial devices in use today. Part I describes the various types of electron tubes and explains their construction and operation. Part II gives you basic circuit components, reviews the fundamental nature of such terms as resistance, capacity and inductance and covers the instruments which measure voltage and current. In Part III the basic electronic circuits are classified into general types, and the necessary parts, the operation, and the common applications of each are described. Part IV shows you how to analyze a complicated circuit and break it down into its component parts, giving standard commercial devices as illustrations.

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City and State .....

Position .....

Company ..... EC 12-44

(Books sent on approval in the United States only.)

DETROITERS attending recent Indianapolis conference, Western Section, I.A.E.I. included Frank Clingan (left) electrical engineer for the Detroit Board of Education and George Antloser, chief electrical inspector at Gratiot Township (Detroit suburb).

pany, of New York, N. Y. and others, decided in July, 1944. The court ruled that OPA did not have the power to control price ceilings on these services when performed for equipment in buildings having nothing to do with a commodity.

MANPOWER SHORTAGE STRANGLES SERVICE ACTIVITIES

Practically every electrical contractor and repair shop in the Twin-Cities area is short-handed, reports the Minnesota Electrical Council, Inc., Minneapolis. Price Regulation MPR 251 prohibits mark-ups on increases in labor costs which have been approved by the War Labor Board since Oct. 3, 1942, and makes no automatic relief provision at all for employers of eight or less employees who were not subject to wage control prior to July 7, 1944. Based on the hardship this regulation has caused, the Council has entered a strong protest and appeal for relief with the OPA.

The net result is that contractors and repair shops can take care of only the most critical needs of their customers and often must turn down new accounts. Because margins on labor alone are not sufficient to carry overhead, many contractors are forced to bypass jobs involving little or no material, or where material is furnished by the owner.

Each contractor is analyzing these conditions in the light of the present situation and attempting to utilize his limited labor supply to the best advantage to himself and his customers.

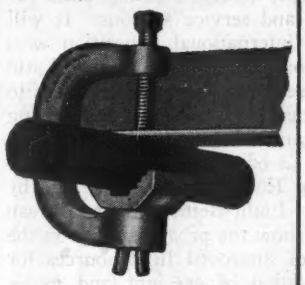
INTERNATIONAL EXPOSITION TO BE HELD NEXT APRIL

The leading lamp and lighting equipment manufacturers of the United States will join together next April 19 to 23, 1945, in the International Lighting Ex-

FLOOR BOXES

LATROBE PRODUCTS

WIRING SPECIALTIES



NO. 470 "LATROBE" Pipe or Conduit Hanger
Unsurpassed for hanging pipe or conduit ½", ¾" and 1" to steel beams up to ⅜" thick.

NO. 285 "LATROBE" DOUBLE DUPLEX RECEPTACLE NOZZLE
Shown with No. 200 Cover Plate. Easy to install, attractive, efficient.

BULL DOG BX CABLE STAPLES
Superior quality. Available in any quantity.

Time Saving
Labor Saving
Dependable

Quick and Easily Installed LATROBE PRODUCTS are forever Trouble Free

Best for all Industrial, Commercial and Residential Jobs

Check your Stock Today

NO. 280 NOZZLE WITH No. 200 Cover Plate
Ten Amp. 250 Volt receptacle in brass housing, ½ in. brass pipe extension.

NO. 150 BOX; NO. 207 NOZZLE
Underwriters' approved. For installation in concrete or in wood finished concrete floors.

"BULL DOG" INSULATOR SUPPORT
Ideal for fastening porcelain or glass insulators to exposed steel framework. No holes to be bored.

QUALITY FULLMAN MANUFACTURING CO. LATROBE, PA. ALWAYS

When You Buy a
BENDER
. . . Check to Make Sure You Get *These* Features

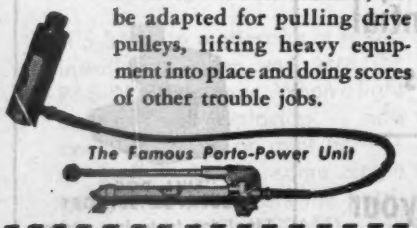
EASY TO GET TO THE JOB
Lightweight and portable, one man can easily carry or roll any Blackhawk Pipe Bender right to the job. Saves time and manpower. Bend rigid conduit and pipe up to 4".

WORK AT ALL ANGLES
Compact hydraulic Porto-Power ram of Blackhawk Pipe Bender works in all directions. Unique design. Avoids kinking. Power eliminates need for heating.

WORK OVERHEAD
All-directional operation and light weight permits work on existing pipe runs.

SIGHT FROM ANY ANGLE
Remote control permits operator to stand in any position necessary to give him full view of job. Blackhawk Benders save need for elbows and couplings and otherwise necessary cutting and threading.

DETACHABLE POWER UNIT *for Extra Utility*
This unit (the heart of the bender) with special available Porto-Power attachments, can be adapted for pulling drive pulleys, lifting heavy equipment into place and doing scores of other trouble jobs.



BLACKHAWK MFG. COMPANY
Dept. P20124, Milwaukee, Wis.
Send full information on your pipe benders.
Name.....
Company.....
Address.....
City.....State.....

BLACKHAWK
Porto-Power
PIPE BENDERS

position at the Palmer House in Chicago to unveil the newest developments in lamps and lighting equipment for industrial plants, schools, offices, stores and similar locations and at the same time show how better lighting is speeding war production and helping to win the war. This will be the largest exhibit of industrial and commercial lighting equipment ever assembled under one roof.

Architects, consulting engineers, building managers, electrical contractors, wholesalers, electrical dealers, school executives and executives of industrial and commercial establishments will have an unequaled opportunity to preview better and more efficient lighting units for offices and industrial plants, new and novel store lighting fixtures, advanced school lighting and new types of floodlighting units for sport areas and service stations. It will be a truly international exposition with many visitors from Canada and Latin America already making arrangements to attend. There will be many interesting and informative displays by manufacturers as well as educational exhibits by the Illuminating Engineering Society and by the Better Light-Better Sight Bureau which will show the progress made in the utilization of improved light sources for the conservation of eyesight and easier and more comfortable seeing.

As part of the Exposition there will be conducted a series of Lighting Conferences at which outstanding men in the field will discuss the latest trends in lighting practice, the most effective means of providing efficient seeing conditions for school children and for office and factory employes. There will also be a symposium on the most effective means of using light for more and better selling.

The International Lighting Exposition is one of the many activities sponsored by the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Association to stimulate better lighting for war production and for the postwar period.

Following is a partial list of exhibitors: The Art Metal Company, Benjamin Electric Mfg. Company, Bright Light Reflector Co., Corning Glass Works, Crouse-Hinds Co., Curtis Lighting, Inc., Day Brite Lighting, Inc., Electro Manufacturing Co., Ender Manufacturing

TENNESSEE TRIO of prominent electrical contractors are (L to R) Adolph Friedman, Friedman Electric Co., Nashville; L. E. "Tobe" Lawson, Lawson Electric Co., Chattanooga; and Dainey Deadrick, Deadrick Electric Co., Nashville.

Safe-T-Glow
HIGH TENSION DETECTOR

SAFETY RULES call for that EXTRA precaution and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

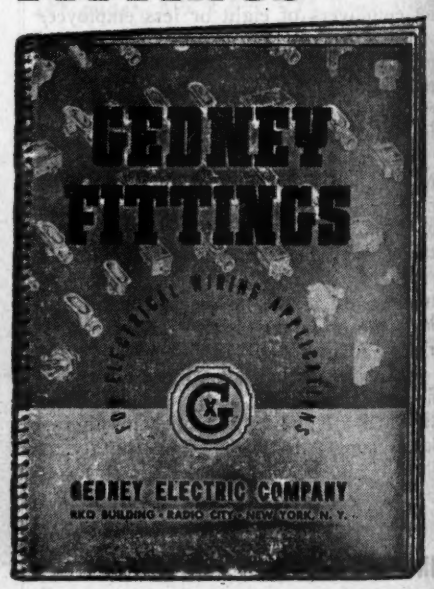
Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

TEST-O-LITE
Tests Everything Electrical from 100 to 550 Volts

Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List Price $1.50 at leading jobbers.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.

SEND FOR THIS HELPFUL DATA
GEDNEY FITTINGS



"Gedney Fittings Fit"
SOLD THROUGH WHOLESALERS
GEDNEY ELECTRIC COMPANY
RKO BUILDING NEW YORK 20, N. Y.

PROMINENT in the activities of the Illuminating Engineering Society are (L to R) past-president Howard M. Sharp, Buffalo, Niagara & Eastern Power Co., Buffalo; technical secretary C. L. Crouch, New York; and Earl W. Fowler, Buffalo-Niagara Electric Company of Buffalo

Corp., Faries Manufacturing Company, Fluores-O-Lite Co., The Fostoria Pressed Steel Corp., General Electric Company, Globe Lighting Products Co., Holdenline Company, Holophane Co., Inc., Jefferson Electric Company, Jones Metal Products Co., Kent Metal Manufacturing Co., Lighting Products, Inc., The Miller Company, Mitchell Manufacturing Company, Overbagh & Ayres Mfg. Co., Philadelphia Elec. & Mfg. Co., The Phoenix Glass Company, Pittsburgh Reflector Co., Quadrangle Mfg. Co., Revere Electric Mfg. Company, Silvray Lighting, Inc., A. L. Smith Iron Company, The Spero Electric Corp., Sylvania Electric Products, Inc., Verd-A-Ray Corporation, The A. F. Wakefield Brass Co., Watco Engineering, Inc., Westinghouse Elec. & Mfg. Co., Wheeler Insulated Wire Co., Wheeler Reflector Co., and The Wiremold Company.

INDUSTRIAL ELECTRONICS COURSE IS POPULAR

More than 100 "students," over 50 percent of them being electrical contractors and their men, are attending the second lecture course on Applied Industrial Electronics held at the New Hamilton Hotel in Chicago. Presented by Arthur G. Mohaupt, B.A., M.S., of DeForest's Training, Inc., Chicago, the two-hour sessions are being held each Thursday evening from Sept. 15 through Dec. 14. Mr. Mohaupt is well known in the Radio-Electronics Field as an engineer, educator and lecturer. A graduate of the University of Wisconsin with a Master of Science Degree in Electrical Engineering, he was also associated with the Illinois Institute of Technology and the Industrial Training Division of Purdue University.

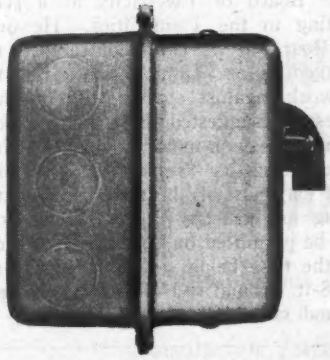
The course consists of twelve lectures covering the following subjects: Review of Electron Tube Fundamentals; Rectifier Systems (and electrostatic air cleaning); Thyratrons and Ignitrons; Electronic Timers and Relays; Electronic Measuring Instruments; Electronic Welding

assured with

Paragon

PRESET TIMERS

2509 for surface mounting



2509 for gang switch box or handy box mounting

Paragon improved manually preset timers can be preset to perform a great variety of operations . . . to allow a given operation to continue for almost any pre-determined time limit . . . to close or open a circuit at the end of the preset time. Synchronous motor operated. Assures absolute accuracy of the timing cycle. Not affected by vibration of changes in ambient temperature. Supplied as standard with single pole, double throw switches and choice of 10 time ranges and 3 types of mounting . . . 2400 series for flush mounting, 2500 for surface mounting, 2900 for wall mounting.

Paragon Chicago

BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

PARAGON ELECTRIC COMPANY

710 Old Colony Bdg. • Chicago 5, Illinois

Mr. Tops, the Paragon symbol of top quality

A **"For Thick-Wall conduit, threadless connection,** I use this bushing.

B **"For Thin-Wall conduit** I put in a bushing like it, but with a smaller grip diameter.

C **"For a Threaded connection** — a solid tapped bushing. *All three are interchangeable.* With a Kondu fitting, you can make ANY kind of connection at ANY outlet!"

And you can **change fittings without disturbing conduit,** because every Kondu box is a union. If necessary you can install a conduit line before you have the fittings.

Vibration-proof . . . Kondu is self-locking . . . gives you a rigid connection, that's permanently tight. Quickest to install. And Kondu is practically unbreakable . . . 100% re-usable.

Write for the Kondu catalog.

KONDU CORPORATION

Erie, Pa.

Kondu Mfg. Co., Ltd., Preston, Ontario

Control; Electronic D.C. Motor Control; Photo-electric Cells and Their Applications; Electronic Elevator Control; X-Rays and Industrial Applications; High-Frequency Electric Heating; and Electronic Lighting Systems (hot and cold cathode fluorescent and high and low pressure vapor lamps).

The course fee of $18.00 has been considered a gilt-edge investment by those who have already received the benefits of attending, many of them being representatives of the foremost industrial concerns in the Middle West. Each lecture is augmented with a series of notes and circuit diagrams which provide a comprehensive reference manual on the subject.

During the summer months this course was also presented at South Bend, Indiana. Numerous requests since that time have lead to the arrangement for a repeat course to be given in that city from Dec. 1 through Feb. 15, 1945. Other organizations interested in having this course can secure details by contacting Mr. Arthur G. Mohaupt, DeForest's Training, Inc., 2531-39 N. Ashland Ave., Chicago 14, Illinois.

REA FAVORS NON-METALLIC BOXES

The use of metallic boxes on non-metallic wiring systems will be prohibited on REA installations as soon as war conditions permit the manufacture of suitable non-metallic boxes, Thomas P. Branch, electrical engineer from the St. Louis office of REA, told the Minnesota State Board of Electricity at a recent meeting in the Twin-Cities. He urged the Board to warn all contractors, now engaged in or planning to do this type of work, against stocking up on metal boxes and suggested those doing exposed wiring use non-metallic surface wiring devices such as "Surfex" or "Surfolet". This may possibly be made a mandatory ruling in the near future. Metal boxes will be permitted on concealed work only for the time being. Acknowledging that the 8-ft. ground rod did not assure good ground connection in all locations, Mr. Branch indicated that REA would undoubtedly sponsor an investigation to determine proper depth in various areas. New construction standards covering line building will specify an 8½-ft. minimum rod instead of the former 8-ft. rod. Following WPB release of critical materials, each REA inspector must make actual resistance tests of all installations and plans are now under way for the development of an inexpensive testing device, he revealed.

The trend of discussions on approved materials and devices indicated that some day soon, REA Cooperatives may demand that all electrical materials, devices and appliances sold to their members must bear Underwriters' Laboratories, Inc., approval—a stipulation that would go a long way towards eliminating the present hazards of farm wiring using home-made and non-approved devices.

E. J. MICKA

Edward J. Micka of Hibbing, Minnesota died November 1st. He was 54 years old. Mr. Micka served on the Board of Directors of the Minnesota Electrical Council since 1933, and for several years on the Executive Committee of the Minnesota Electrical Association. He was a past president of both organizations and in January 1943 was appointed by Governor Stassen to a five year term on the Minnesota State Board of Electricity.

NEMA DECLARES ELECTRICAL INTERDEPENDENCE

The greatest volunteer army of unofficial salesmen-educators in history will be organized to induce America to "think electrically" under a program launched by the National Electrical Manufacturers Association.

Several hundred thousand employees in member company plants will be asked to take part in a nationwide campaign to stimulate interest in the benefits to be derived from electricity through use of electrical appliances and equipment.

The program was inaugurated follow-

105 YEARS OF EXPERIENCE is represented by these four technicians of the San Antonio Armature Works, San Antonio, Texas. They are (L to R) Harold S. Foster, H. S. Foster, Herbert S. Foster and Paul Kane. During his 50 years in repair work, H. S. Foster has set up motor service departments in Africa (Gold mining), Mexico (Copper mining), and in England.

ing the adoption of a "Declaration of Electrical Interdependence" in which the association reaffirmed its obligation to the American public "to use the great power of electricity to make living and working conditions better, healthier and happier." The NEMA members also pledged themselves to the industry-wide cooperative educational campaign.

The salesmen-educators will be enlisted at member company plants through a drive to demonstrate: (1) that employe prosperity and plant prosperity are closely interlocked with the welfare of the entire industry; (2) that every employee can, by personal effort, increase public interest in the benefits to be obtained from electricity through the use of the products and services of the industry.

N. J. MacDonald, vice president of Thomas and Betts of Elizabeth, N. J., and chairman of the session at which the members endorsed the plan, emphasized that employee participation would be entirely voluntary.

"There is no better way to bring the myriads of healthful and helpful uses of electricity to public attention than through personal contacts," he asserted. "The employees in our member plants together with their families total a substantial percentage of the nation's population. If all these preach electricity and set a personal example, the benefits to the industry would be tremendous."

The "Declaration of Electrical Interdependence" which the convention adopted stresses the need for active mutual support of each other by the several segments of the industry and emphasizes the electrical manufacturers' obligation "to make better products and more products for less money" for the public good.

Leonard Kebler of Mount Vernon, N. Y., president of NEMA and chairman of the Board of the Ward Leonard Company, affixed his signature to the document asserting, "I believe that the adoption of this declaration is a long step toward fulfillment of our hopes for a truly electrical world."

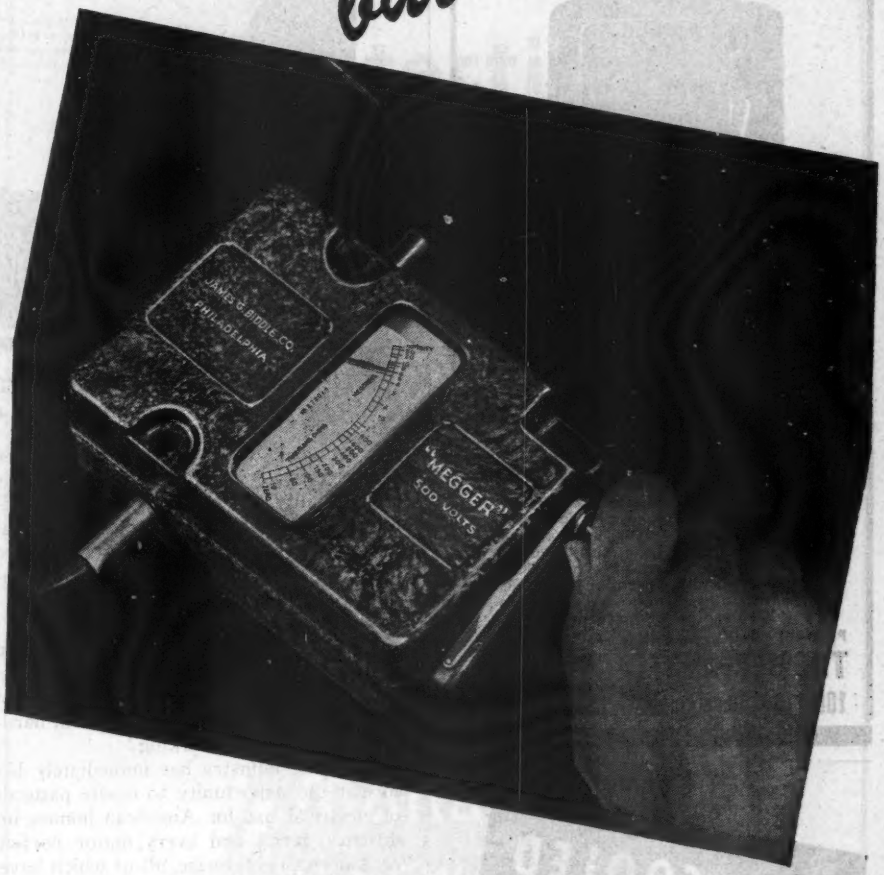
Mr. Kebler also presented the "NEMA Certificate of Recognition" to five industrialists who have completed 50 years in the electrical manufacturing field. They are: J. B. Wants, General Electric X-Ray Co.; Arnold H. Friend, M. B. Austin Co. and Godfrey H. Atkin, Electric Storage Battery Co., all of Chicago; W. I. Patterson, Steel City Electric Co. of Pittsburgh and E. H. Hammond, Kennecott Wire & Cable Co., Phillipsdale, R. I.

The declaration was read to several hundred members and a number of distinguished guests at a luncheon at the Waldorf Astoria. Included among the guests were A. B. Cooper, president of the Canadian Electrical Manufacturers Association, officers of the New York Electrical and Gas Association and Stanley Johnston, war correspondent and author, who talked on "Technical Warfare."

The text of the declaration:

When, in the course of scientific progress, the great power of electricity was first directed to the service of mankind, and in the brief measure of these sixty-five electrifying years has transformed

Small . . . but MIGHTY!



. . . the MIDGET "MEGGER"* TESTER is ALWAYS READY FOR USE . . . ANYWHERE

Weighing but 3 pounds, this mighty midget can be carried in a coat pocket or tool kit . . . instantly available for testing insulation resistance of practically all types of electrical equipment . . . indispensable for maintenance and trouble shooting, even where the higher range "Megger" sets could be used. Reads up to 50 megohms and delivers 500 volts D.C. from a built-in hand-cranked generator, making it independent of batteries or external power supply.

If you are not already familiar with this smallest and in many ways the most remarkable instrument bearing the "Megger" trademark, write for Bulletin 1545-EC.

*Trade Mark Reg. U.S. Pat. Off.

Ask also for Bulletin 1735-EC describing the new U. S.-made "Megger" Testers.

JAMES G. BIDDLE CO.

1211-13 ARCH STREET • PHILADELPHIA 7, PA.

AUSTIN
TIME SWITCHES

Type "S"
Standard Synchronous Model

● Indoor Model—straight "on" and "off"—dust proof—slow speed motor —snap action switch.
Accurate and durable for controlling signs, attic fans, stokers, oil burners, blowers, pumps, valves, motors, and all commercial lighting. Only two exposed gears—modern case and glass window to check operation—no tools or extra attachments needed. See your Wholesaler for more details.

PROMPT Delivery—Rating A-5 or Better

THE M. B. AUSTIN COMPANY
108-116 S. Desplaines St., Chicago 6, Ill.

Newly designed pressed steel covers reduce weight, new mounting brackets simplify installation. Acme Air Cooled Power Transformers now available in sizes 1/10th to 50 KVA. Single and 3 phase, all standard voltages up to 2400 primary. ***Write for Bulletin 160A.***

THE ACME ELECTRIC & MFG. CO.
CUBA, N.Y. **CLYDE, N.Y.**

Acme Electric
TRANSFORMERS

LEONARD KEBLER signing the "Declaration of Electrical Interdependence", which was adopted by NEMA.

our national life, a decent respect for the electrical manufacturing industry's responsibility toward the coming Electrical Age requires that all electrical manufacturers shall now publicly declare their sense of obligation and interdependence.

We hold these truths to be self-evident:

That it is the manifest destiny and privilege of our industry to remove from the American scene every last vestige of avoidable, unnecessary and wasteful hardship in living and working!

That our industry has immediately before it the opportunity to create patterns of electrical use for American homes, industries, farms and every major portion of American enterprise, all of which have, until the present, used but a fraction of the strength of electrical service that is theirs to command;

That we, the members of the National Electrical Manufacturers Association, who have learned a new spirit of cooperation and reached unimagined achievements in the fire of world conflict, do fully realize the true measure of our industry's responsibility to the future economic health, welfare and progress of our beloved country;

That, in consequence, our electrical manufacturing industry can and does say to the American people—"We can help industry make better products, and more products, for less money, thus helping to create and maintain the high levels of employment vital to our future;"

That it can and does say to the American people, "the great power of Electricity will make your living and working conditions better, healthier and happier;"

Therefore, the men and women of the industry who today deal with this great force now grown from a single glowing filament into a billion-pronged servant of progress, realizing their obligations and the increasingly complex character of their respective undertakings, do hereby declare—

RESOLVED—that all Members of the National Electrical Manufacturers Association recognize their common cause for national progress into the Electrical Age; that all recognize the factor of electrical interdependence between branches within our industry; that all will henceforth be ardent supporters of the electrical idea to the end that this Declaration of Electrical Interdependence shall become a living document in honor of our pioneers and in trust for the welfare of those who follow.

ORDER L-78 AMENDED

Manufacture of certain types of fluorescent lighting fixtures which has been prohibited, is now permitted when these fixtures are provided with ballasts or transformmers that control two or more lamp tubes, the War Production Board has announced.

Additional types permitted by today's amendment to Order L-78 are those designed for a continuous row of single tubes rated 40 and 100 watts per tube. Fxtures for a continuous row of single tubes rated 15, 20, or 30 watts each are still prohibited.

The amended order also makes the following changes:

Permits the manufacture of individual or continuous row fixtures using five or more rows of tubes. Such fixtures normally employ ballasts that control two or more lamps, WPB officials pointed out.

Removes provision requiring WPB authorization for the sale on unrated orders of fluorescent lighting fixtures that were in inventory on June 2, 1942. Any remaining stocks of such fixtures may now be released for sale on unrated orders only through appeals procedure.

Limits the sale of parts to be used for maintenance and repair to rated orders. Formerly, repair parts could be sold on unrated orders.

Adds an interpretation of the order, in the form of seven questions and answers, one of which clarifies some uncertainties that have existed with respect to the so-called "kitchen units."

A STUDY OF HOUSING COSTS MADE BY NHA

Research aimed at the development of more efficient building materials and to devise more effective means of using them so that a far greater proportion of American families can afford to buy new homes was recommended in a study of "Housing Costs" made by the National Housing Agency.

The study disclosed that 60 percent of the total cost of an average single family dwelling is represented by the "shell" of the house—the structural enclosure, including the foundation, roof, floors and walls. Therefore, it was concluded that the most promising approach to bringing down the cost of a house lies in the field of devising new and less costly materials out of which the "shell" is constructed.

A foreword to the NHA report, which was prepared by the Technical Division, declared:

"If housing is to assume its proper place in the national economy, costs must be substantially reduced without sacrificing standards of quality."

The report considered only items of cost involved in the construction, maintenance and ownership of houses. Although it was limited to single-family houses, most of the conclusions reached apply to rental properties as well. The report did not include a study of methods of financing but stated:

"Although the reduction of interest rates, property taxes, and maintenance expenses are important in any consideration of ways to reduce the cost of owning or renting houses, by far the most effective way to reduce monthly cost of home ownership is to secure reductions in the capital cost of the house and land."

For example, the survey showed, that if a 20 percent reduction in the cost of the property (land and house) is achieved, it is more than three times as effective in reducing monthly costs as a 20 percent reduction in the rate of interest charged for a mortgage loan.

For instance, total monthly payments and costs of a $5,000 house would be cut 5.4 percent over a 25-year period by a reduction in the interest rate from 5 percent to 4 percent, while a reduction in construction costs from $5,000 to $4,000 would cut monthly payments by 16.4 percent. Over a 40-year period, the comparative saving through lower construction cost would be even greater.

Following are the costs of a typical $5,000 house (including land costs) as used in the NHA survey:

1. Cost of Materials at Site

Lumber	11.85 percent
Masonry	3.45
Concrete and mortar	3.33
Plaster, lath and wallboard	4.27
Insulation	0.24
Roofing	1.25
Flooring	2.95
Millwork	7.36
Paint	1.41
Finish hardware	0.71
Plumbing	5.48
Heating	1.42
Electrical	0.98

Dependable Protection

MONARCH FUSE COMPANY, LTD.

116 E. FIRST STREET JAMESTOWN, N. Y.

CHICAGO

EXPANSION NUTS

The Dependable Machine Screw Anchors

For machine screw or machine bolt anchors, it will pay you to specify Chicago Expansion Nuts. These dependable anchoring devices offer the following advantages:

1. **Quickly installed—a few hammer taps sets them.**
2. **Work can be easily dismantled.**
3. **No part of the anchor projects after removal from floor or wall.**
4. **Large stocks—IMMEDIATE DELIVERIES.**

Chicago Expansion Nuts have standard machine screw threads. Available in all sizes from No. 6 up to and including ¾". Setting tool free of charge.

IMMEDIATE DELIVERIES

Write for New Catalog or call your wholesaler.

CHICAGO

CHICAGO EXPANSION BOLT COMPANY

2231 W. Ogden Ave. • Chicago 12, Ill.

HEAVY DUTY

Carbon Lamps

FOR INDUSTRIAL USE

• Recommended for use where *Long Life* is essential, where *Vibration* is excessive, where *Inaccessibility* of lighting fixtures makes *Replacement Difficult*, where a *Pilot Light* is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.

NALCO

NORTH AMERICAN ELECTRIC LAMP CO.

1044 Tyler Street — St. Louis 6, Missouri

Miscellaneous	1.00
All materials	45.70
2. Cost of site Construction Labor	29.50
3. Contractor's and Subcontractors' Overhead and Profit	12.30
4. Total Cost of House..	87.50
5. Value of Unimproved Land (including profit on land)	7.00
6. Cost of Land Improvements (including profit on improvements..	5.50
7. CAPITAL COST	100.00

Housing costs are high, the report said, because the home building industry which is made up in large part of numerous small business enterprises, has been unable to undertake scientific industrial research on a sufficiently broad scale to bring down costs on a scale comparable with modern mass production industries.

FUNCTIONS OF OCR OUTLINED IN NEW ORDER

An order outlining the organization and functions of the Office of Civilian Requirements has been announced by the War Production Board. Only the position and duties of the Vice Chairman for Civilian Requirements had been established heretofore. The new order gives formal recognition to the structure built by the vice chairman and formalizes functions that he has been performing in addition to those established heretofore. Among them are the following, as described in the text.

Participation "in the review of plans for cut-backs in military and other war programs" and recommendation of the "facilities most suitable to release in order to resume or expand the production of goods and services, for which he acts as claimant, which are of the greatest benefit to the civilian economy."

Specification of "the kinds, categories, and amounts of goods and services, for which he acts as claimant, which should be provided first as resources become available as a result of cut-backs or other changes in war requirements."

Another change made by the new order makes the Government Division, now operating as a separate unit under the Vice Chairman for Civilian Requirements, an OCR bureau.

"The change recognizes the importance of the service that the Government Division has been rendering Federal, State, county and local governments, educational and welfare institutions and churches," WPB officials said.

Essential civilian supplies will continue to receive OCR's protection until it is clear that demand and supply are coming into balance, J. A. Krug, WPB Chairman, said in outlining the functions that he believes OCR will have to perform in the public interest.

"The Office of Civilian Requirements must be on the alert to watch developments in the civilian supplies that support an effective war effort," Mr. Krug said.

Under the new order, OCR will continue to have the following functions in protecting essential civilian supplies.

1.—Seeing to it that sufficient supplies are maintained to meet essential civilian requirements.

2.—Seeing to it that the products in short supply are fairly distributed to all parts of the country in accordance with essential needs.

3.—After consultation with the industry divisions, certifying to the Office of Price Administration, under the terms of the Vinson directive, those cases in which production is being held up by need for suitable price action.

4.—Watching the claims for the export of any short supplies, so as to protect the essential supplies for United States civilian consumers.

MAINTENANCE ENGINEERS DISCUSS ELECTRONICS AND RUBBER

At the November meeting of the Electrical Maintenance Engineers Association of Southern California, Nov. 15, in Los

LIGHTING SERVICE FORUM at recent I.E.S. Technical Session in Chicago was conducted by the following organization representatives: (L to R) W. A. Stannard (E.E.I.); J. S. Schuchert (B.L.-BS. Bureau); E. C. Huerkamp (N.E.M.A.) Ward Harrison (I.E.S.); R. W. Staud (R.LM. Institute); A. F. Wakefield (Fluer-O-Lier Mfgrs.); and Paul Tysinger, Duke Power Co., forum chairman.

AIRPORT LIGHTING improvements developed by the Army and Navy for adverse weather conditions at advance bases were outlined by Major Wilbur T. Harding, U S. Army Air Corps Equipment Laboratory, Wright Field, Dayton, Ohio, at recent I.E.S. Technical Session in Chicago.

Angeles, it was announced that all legal aspects had been worked out to permit incorporation of the association as a non-profit organization under the laws of California. The articles of incorporation were read and approved unanimously by the membership, to be sent to Sacramento for conclusion of the details.

The program of this meeting included the third lecture on electronics, presented by Mr. Fiske of the Westinghouse Electric & Manufacturing Co. After the dinner, a very complete summary of the synthetic rubber situation was presented by F. S. Carpenter, general manager and Howard C. Park, maintenance engineer, of the Torrance plant of the U. S. Synthetic Rubber Corporation, with a corps of departmental experts.

From the discussions, it can be gathered that the West Coast has now arrived at the stage of being self-sufficient in the production of rubber and practically all rubber products; this from the standpoint of post-war requirements. It was furthermore learned that, in connection with the manufacture of rubber insulated wire, it is now possible to take the latex in solution, add certain other ingredients, and run the wire through it to acquire an insulating covering of improved characteristics.

As a highly interesting feature of the program, Harry Fore, of the Goldak Co., Los Angeles, demonstrated an electrical device for metal detection. This involves an application of electronics, basically a loop antenna made to oscillate and set up a figure-8 field of force about itself. If, then, a pick-up loop is added, in which voltage is induced by the field, a humming sound is heard. But placing the pick-up coil tangent to the curve of the oscillating field, no current is induced in it at that neutral point and the sound ceases.

After adjustment at the neutral point, if a piece of metal is introduced in the

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Tomorrow's Starter Today!
New! Distinctive!

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2 When trouble is detected the starter automatically cuts off current to the ballast and lamp.
3 Gives long life to ballast because defective lamp is locked out. Prevents overheating.
4 When Lloyd AUTOMATIC locks out defective lamp — turn off the current — Remove defective lamp—Put in a new lamp.
Allow at least one minute to make the above change of lamps. Turn on the current. The starter automatically lights the new lamp.
NO NEED TO DO ANYTHING TO THE STARTER
5 Lloyd NEW PLASTIC CAN has higher dielectric strength, is stronger, lighter, distinctive.
6 Knurled rim on plastic can insures positive grip for insertion and removal of starter.
7 Plastic can is sealed. No projecting lugs to cause trouble.
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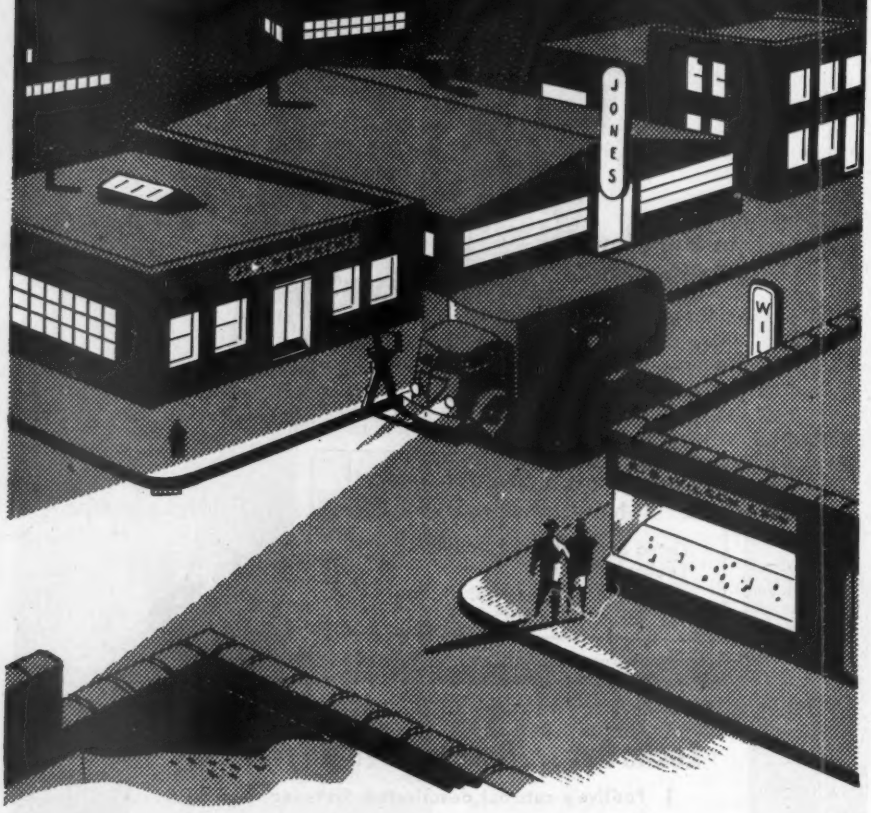

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oscillating field, eddy currents are set up in the metal. The effect of these eddy currents is, in turn, to distort the whole oscillating field. The pick-up coil is then thrown out of "groove", so to speak, current is induced in it, and the hum is again heard. Briefly, adjust the gadget to neutral—no sound. Walk over a piece of iron, gold or other metal, the field is distorted and humming starts.

The company has been "finding things" for the utilities for some time, such as locating un-mapped pipe lines, electric cables, lost valve covers, etc. Of late, however, the device has been applied to all sorts of manufacturing and processing problems.

DATES AHEAD

Electrical and Gas Association of New York, Inc.—Lecture course on "Electronic Applications in Industry," 480 Lexington Avenue, New York, N. Y., December 7.

Association of Electrical Construction Engineers—Regular meeting, 2 Park Avenue, New York, N. Y., December 11.

George Washington Chapter IAEI—Monthly meeting, District Building, Washington, D. C., December 11.

Cook County Electrical Contractors Association—Monthly meeting, Electric Association Dining Room, Chicago, Ill., December 11.

Central District Chapter, NISA.—Monthly meeting, Electric Association Dining Room, Chicago, Ill. December 12.

Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., December 12.

Independent Electrical Contractors Association, Inc.—Headquarters of Electrical & Gas Association, 480 Lexington Ave., New York, N. Y., December 13.

Electrical Contractors Association of City of Chicago—Monthly meeting, Electric Association Dining Room, Chicago, Ill., December 13.

Electrical Institute of the Tri-Cities—Auditorium, Iowa-Illinois Gas & Electric Co., Rock Island, Ill., December 14.

Chicago Electrical Estimators Association Monthly meeting, Chicago Engineers Club, Chicago, Ill. December 18.

Electrical and Gas Association of New York, Inc.—Christmas luncheon, Grand Ballroom, Hotel Astor, New York, N. Y., December 20.

Roger Williams Chapter IAEI—Monthly meeting, Providence, R. I., December 20.

Utah Chapter IAEI—Monthly meeting, Auditorium of Utah Power and Light Co., Salt Lake City, Utah, January 2.

Rocky Mountain Chapter IAEI—Monthly meeting, Denver, Colo., January 9.

Louisiana Engineering Society—Annual meeting, St. Charles Hotel, New Orleans, La., January 11-13.

Kentucky Chapter IAEI—Louisville, Ky., January 11 and 12.

National Association of Home Builders—Postwar Exposition, Hotel Sherman, Chicago, January 15-20.

Roger William Chapter IAEI—Monthly meeting, Providence, R. I., January 17.

American Institute of Electrical Engineers—Technical Meeting, Engineering Societies Building, New York, N. Y., January 22-26.

Indiana Chapter IAEI—Antlers Hotel, Indianapolis, Ind., February 1-2.

Wisconsin Electrical Association—Annual conference, Milwaukee, Wis., February 17-18.

National Industrial Service Association—Annual conference, LaSalle Hotel, Chicago, April 16-18.

National Electrical Manufacturers Assn.—Spring Conference, Palmer House, Chicago, Ill., April 16-19.

Electrical Committee, N.F.P.A.—Edgewater Beach Hotel, Chicago, Ill., Week of May 14.

American Institute of Electrical Engineers—Summer Technical Meeting, Hotel Statler, Detroit, Mich., June 25-29.

International Lighting Exposition—Palmer House, Chicago, Ill., April 19-23.

National Electrical Wholesalers Assn.—Spring meeting, April 23-25.

MANUFACTURERS NEWS

TRUMBULL ELECTRIC ELECTS NEW OFFICERS

The executive officials of the Trumbull Electric Mfg. Co. of Plainville, Conn., who founded the business in 1899 and have managed its affairs ever since, have resigned from active service, effective December 31. They are, John H. Trumbull, president; Frank T. Wheeler, vice president; Henry Trumbull, treasurer; and Stanley S. Gwillim, secretary and general manager.

The newly elected officers are Elmer T. Carlson, president; Robert C. Graves, vice president in charge of sales; Cecil A. Bedford, vice president in charge of manufacturing; Herman A. Papenfoth, secretary and treasurer; and Richard L. Goodwill, assistant secretary and treasurer. These officers will take over their new duties on January 1, 1945.

Elmer T. Carlson, the newly elected president, is at present manager of the Trumbull works at Norwood, Ohio. He is an electrical engineer and joined the Trumbull organization in 1928 as a sales representative in the Boston office district, later being transferred to the old Trumbull Ludlow factory as sales manager, and a few years ago he became general manager of the Norwood works.

Robert C. Graves, the newly elected vice president in charge of sales, is an electrical engineer, graduating in 1918 from the Rensselaer Polytechnic Institute. Immediately upon graduation he served as an ensign in the U.S.N.R.F. in World War I. After he had been discharged from these duties he joined the Trumbull Company as an estimator in the Switch and Panel Division, of which division he became manager in 1922 and held that position until 1935 when he became director of sales, which position he now holds.

Cecil A. Bedford, vice president in charge of manufacturing, joined the organization in 1917 as a draftsman. After working through various departments, he became managing engineer, which position he now holds.

The Trumbull Electric Mfg. Co. is a General Electric owned organization, operating independently under its own management.

WESTINGHOUSE ANNOUNCEMENTS

Because of the expanding rural market for electrical appliances and farm equipment, the Westinghouse Electric & Manufacturing Company has organized a new department to develop its participation in that field. Alvan D. Peabody has been named head of this department called Rural Market Development. Under Mr. Peabody, the Rural Market Development program will include analyzing the farm market and working with various product departments to develop appliances that fit farm needs.

W. Ross Arbuckle has been appointed manager of the Home Building Department, of the Westinghouse Electric Appliance Division, Mansfield, Ohio. He will develop a merchandising program on planned kitchens and laundries for homes and apartments and expand the company's activities on major appliances in the apartment and multiple housing field.

W. O. Lippman has been reappointed manager of the Electric Appliance Division Works, East Springfield, Mass., a position he relinquished in April, 1943, to become manager of the Canton, Ohio, Ordnance Division. Mr. Lippman will retain his Ordnance Division post and will divide his time between the two plants. In his absence from the Canton plant, J. C. Smith, newly appointed manager of manufacturing there, will be responsible for the operation of the Division.

Paul H. Eckstein has been appointed assistant sales manager of the new Radio Receiver Division of Westinghouse. Mr. Eckstein was formerly with the Stewart-Warner Corporation where he had been sales promotion manager.

CURTIS LIGHTING CHANGES

Melvin C. Wilt, released from active duty as a Lieutenant-Commander in the Supply Corps, U.S.N.R., has returned to carry on his previous duties as executive vice president and general manager of Curtis Lighting, Inc., and president of Curtis Lighting of Canada, Ltd.

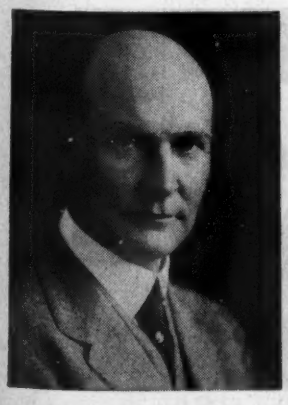
Gerald T. Morrow, who has assumed Mr. Wilt's duties during his absence, will return to his former position of vice president in charge of sales.

U. S. RUBBER CO. APPOINTMENT

The United States Rubber Co. has announced the appointment of Herman A. Everlien as general sales manager of the mechanical goods division and Walter F. Spoerl as merchandise manager. Both positions are newly created.

Mr. Everlien and Mr. Spoerl began their careers at early ages as clerks in the sales department of the old Revere Rubber Co. in Chicago, later consolidated into the United States Rubber organization. In 1924 Mr. Everlien was transferred to New York as manager of branch sales, the position he held until

H. A. EVERLIEN



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MULTI Units will give you the proper start on post-war lighting sales. Our war work comes first now, but this same war work has brought out and emphasized the need for good lighting in stores, plants, shops, offices, etc. The MULTI line is complete for Commercial and Industrial work.

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Electrical Connectors

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appointment to his new post.

The U. S. Rubber Co. has agreed to purchase the assets and business of the L. H. Gilmer Co. of Philadelphia, manufacturers of industrial V-belts. Herbert E. Smith, president of the Rubber Co., said that the purchase was made to round out further the mechanical goods division. He added that no change in the management or operations of the Gilmer Co. is contemplated. John S. Krauss, president, will continue in the active management of this business.

G-E APPOINTMENT

W. H. Dennler has been appointed assistant to the general sales manager of the General Electric Company's appliance and merchandise department. During the war Mr. Dennler was supervisor of personnel replacement. He joined G-E in 1933 when he entered their business

W. H. DENNLER

training course in Schenectady and was transferred to Bridgeport in 1936 from the traveling auditor's staff. Following his transfer from Schenectady he supervised the clerical service bureau of the department, spent a year in the field studying appliance dealer operations, and was on the auditor's staff assigned to work with independent distributors when war cut short civilian goods production.

ALLIS-CHALMERS APPOINTMENTS

The appointment of A. J. Schmitz as Pacific regional manager of Allis-Chalmers Mfg. Co. was recently announced. Previous to his appointment, Mr. Schmitz was manager of the Allis-Chalmers Seattle office, and prior to that manager of the Portland office. He has been with the company since 1914.

Earle Lancaster has joined the Allis-Chalmers Co. in the Los Angeles district office as a specialist in switchgear and related equipment. E. J. Baireuther will be in the Denver office as a specialist in electrical apparatus and in cement, crushing and mining machinery.

Three appointments in the electrical department of the Allis-Chalmers Co. were also announced. F. C. Ludington was named assistant to W. S. Edsall, manager of the switchgear and control sections of the electrical department. Mr. Ludington has been with the company for 21 years and was previously employed by the Cutler-Hammer Co. in its engineering department. J. S. Morgan has been appointed sales engineer in charge of switchgear sales, succeeding Mr. Ludington. W. M. Pickslay was named assistant engineer in charge of the control section of the electrical department.

WESTINGHOUSE SUPPLY APPOINTMENTS

David M. Salsbury has been elected vice president and general manager of the Westinghouse Electric Supply Company. In his new position Mr. Salsbury

D. M. SALSBURY

will head the company's operations, reporting to the president.

Charles G. Lammers has been appointed manager of the Indiana Division with offices in Indianapolis. Mr. Lammers was formerly with Westinghouse Electric & Manufacturing Company.

Thomas W. Cunnea has been appointed branch manager of Westinghouse Electric Supply Company's office in Houston, Texas. He succeeds C. M. Mackey, who was recently transferred to a new post in Dallas.

VIKING PROMOTION

Viking Air Conditioning Corp., of Cleveland, Ohio, has announced the appointment of Frank P. Gibbons as sales mana-

F. P. GIBBONS

ger. Mr. Gibbons joined the Viking organization in 1935 and he has been purchasing agent and assistant sales manager. Previous to his association with Viking, Mr. Gibbons was connected with the Monmouth Products Humidifier Division, Cleveland, Ohio.

GRAYBAR PROMOTIONS

R. W. Kimberlin, local manager of the Graybar Electric Co., recently moved up to the position of Mississippi Valley district manager with headquarters in St. Louis, and jurisdiction of the Graybar office and warehouse in Memphis, Tenn., as well as those in St. Louis.

S. B. Cooper, Graybar manager at Phoenix, Ariz., has taken over Mr. Kimberline's duties in Salt Lake City.

E. E. Leavy succeeds Mr. Cooper as Graybar manager in Phoenix, Ariz. He has served as a Graybar field representative in the Phoenix territory since 1937.

F. L. Cummings recently took over the duties of commercial manager for Graybar in the Tulsa office.

●

Sylvania Electric Products Inc. announces the appointment of R. G. Slauer as manager of the Applications Laboratory, with headquarters in Salem, Mass. Mr. Slauer has been in the lighting industry for over 18 years and has been associated with the Westinghouse Company for the past 14 years.

●

American Steel & Wire Company, Cleveland, Ohio, announces the appointment of C. E. Plass as district engineer in the electrical sales division of the Chicago Office. Victor Siegfried succeeds Mr. Plass as chief research engineer of the Electrical Cable Works at the company's South Works in Worcester, Mass.

●

The Standard Transformer Co. of Warren, Ohio, has named R. E. Andrew, formerly president of the Pennsylvania Oil Co. at Madison, Wis., as its representative in Wisconsin. Mr. Andrew's headquarters will be at 2412 W. State St., Milwaukee, Wis.

●

Cutler-Hammer, Inc., Milwaukee, Wis., has opened a new sales office at 108 N. Main St., South Bend, Ind. Mr. Terry Fisher, South Bend representative, will be in charge.

●

The Copperweld Steel Company, Glassport, Pa. announces the appointment of F. E. Leib as assistant general manager of sales. He has been with the Copperweld Steel Company since 1936.

One stroke brings shoe into position

ONE MAN can bend pipe *fast* with a GREENLEE Hydraulic Pipe Bender. It takes but a few minutes to get smooth, precise, uniform bends — simply and easily.

For example, as illustrated, one stroke of quick-positioning lever brings shoe snug against pipe, ready for application of bending pressure. Tedious hand-pumping for shoe positioning is eliminated with this GREENLEE-engineered "short cut". You're now ready to transfer handle to operating lever and apply powerful hydraulic pressure for the exact bend you want—immediately!

Whether you're bending pipe, rigid and thin-wall conduit, bus bars, tubing—*from* ¾" *to* 4½"—you'll find it simple as A. B. C. with a GREENLEE. This means important labor and material savings on every bending job—large or small.

Get the entire story on GREENLEE Benders and other time-saving tools for electrical workers. Write for Catalog 33E — free — Greenlee Tool Co., Division of Greenlee Bros. & Co., 1752 Columbia Ave., Rockford, Illinois.

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SIMPLICITY PLUS!
New NON-INDUCTIVE CABLE RACK

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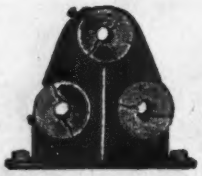

Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2⅝".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushings.

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The Revere Line is complete, covering units for Airport, Marine—Industrial and Sports use. Write for Catalog supplements.

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Originators of the Hinged Floodlight Pole
INDOOR and OUTDOOR LIGHTING EQUIPMENT of EVERY DESCRIPTION

Army Fights Eye Trouble With Light

[FROM PAGE 57]

level. John G. Hellman Company of Brooklyn was awarded the electrical contract.

Three 4-tube, 40-watt white, eight foot fixtures were installed per room as per the accompanying sketches. Mounting heights above the desk tops were 6 feet 8½ inches, and center distances were 3 feet 9½ inches. Wall switches permitted lighting either the center unit, the two outside units, or all three simultaneously. Painting was carried out as per recommendations and measurements revealed that ceilings and top sidewalls had a reflection of 77 percent; walls 54 percent; floors and furnishings 15 percent.

Illumination and brightness measurements were made with the fixtures new and clean and with clean, newly painted walls and ceiling. Lamps had been operated for 1500 hours and were E.T.L. calibrated. Electrical Testing Laboratories, Inc., made the tests.

Illumination on the study table averaged 45 foot-candles: at 45 degrees to the vertical averaged 23.8 foot-candles; at horizontal (corners of 10 foot square in center of room and 31 inches above floor) averaged 29.8 foot-candles. Average brightness values were 106 F. L. and 221 F. L. for the darkest and brightest spots.

The wiring was found to be in worse condition than indicated by preliminary examination. Consequently, most of the branch circuits were pulled in new through existing conduits using No. 12 wire. The single existing ceiling outlet was utilized for the center fixture with Wire-mold used to connect the center unit with the two outside fixtures. Lighting panels which were located in the barracks basements remained in use and are of the fused, live-front type.

Five obsolete main switchboards were replaced by new modern circuit breaker type panelboards. All distribution mains were changed over from single phase, three-wire, 120 volts to three phase, four-wire, 120/208 volts by pulling a bare neutral into existing conduit mains. Network distribution is now in use to provide better loading and greater protection against outage.

In two cases where the services from the street mains were inadequate, wire sizes were increased to accommodate the growth of the lighting load.

TABLE III

VISUAL EFFICIENCY RATINGS

American Medical Association Equivalent of Visual Efficiency			New York State Compensation Commission Ratings	
English Fraction in Feet	Efficiency	Loss	Efficiency	Loss
20/20	100.0	0.0	100.0	0.0
20/30	91.5	8.5	66.0	33.0
20/40	83.6	16.4	50.0	50.0
20/50	76.5	23.5	40.0	60.0
20/70	64.0	36.0	28.5	71.5
20/100	48.9	51.1	20.0	80.0
20/200	20.0	80.0	.....	....

TABLE IV

Class of January 1943 Lacking 20/20 vision*		Class of June 1943 Lacking 20/20 vision*	
Vision	No. of Cadets	Vision	No. of Cadets
20/200	2	20/200	1
20/100	9	20/100	3
20/70	10	20/70	14
20/50	18	20/50	15
20/40	27	20/40	41
20/30	22	20/30	37
20/25	2	20/25	8
Total Cadets:	90		119

All these Cadets had 20/20 vision upon entrance to the Academy
*Grouped according to vision of poorer eye.

TABLE V

STUDY OF PROGRESS OF VISUAL DEFECTS IN GRADUATES COMMISSIONED IN THE U. S. ARMY—CLASSES 1936 and 1937

Classes '36 & '37		No. with vision below 20/20	State of vision one year after graduation: Return to 20/20 vision	Vision Improved but not to 20/20	Vision Unchanged	Defect Progressive
Class '36	On Entrance	29	8	11	4	6
	Following Entrance	54	31	19	3	1
	Total Defects	83	39	30	7	7
Class '37	On Entrance	25	2	10	9	4
	Following Entrance	52	22	19	2	9
	Total Defects	77	24	29	11	13
Two Year Total	On Entrance	54	10	21	13	10
	Following Entrance	106	53	38	5	10
	Total Defects	160	63	59	18	20
	Percent (%)	100%	39.4%	36.9%	11.2%	12.5%

Phos-Copper Brazing of Armature Coils

[FROM PAGE 60]

justments for varying the value of the brazing current, is satisfactory. Such portable equipment is available and includes a set of brazing tongs with carbon tips attached to the jaws. See photo showing this equipment in use.

Approximately 125 to 250 joints can be brazed with one set of carbon tips. Since the tips are small and inexpensive, the cost of carbon tip replacement is low. The portable brazing set not only includes a set of brazing tongs but also has connections for air supply, with suitable valves. These magnetic valves operate automatically in the proper sequence and supply the air to the joints being brazed whenever the current supply is opened. All that is necessary is to connect an air supply to the connection provided on the transformer case. This equipment is mounted on wheels to make it readily portable in the shop.

On the armatures of d-c machines, there are cross connections between points of equal potential, usually two pole pitches apart. Cross connection joints are ordinarily spaced approximately 2½ inches apart around the armature periphery and are normally located at the rear of the machine. The standard method of joining cross connections to armature coil clips has been by riveting and soldering. When using brazed joints for these connections, the riveting can be omitted. The cross connector can be brazed to the armature clip in the same manner used for commutator necks. In factory production, the brazing material (in the form of thin strips) is attached to the armature coil clips by means of spot welding, before winding.

Phos-copper brazing can be applied not only to commutator neck and cross connections but to many other jobs as well. It can be used on stators of a-c machines, on induction regulators, transformers, etc. It is not necessary to prelocate the brazing strip material since it can be fed to the work in the form of small rods about ⅛-in. in diameter. In d-c machines, Westinghouse has used phos-copper brazed joints for attaching cross connection clips to armature coils themselves for the past fifteen years. Never has there been a single failure of this brazed joint. Similarly on the stators of d-c machines, phos-copper brazing on leads from brushholder brackets to brushholder cross connection rings, have been used 15 years without failure.

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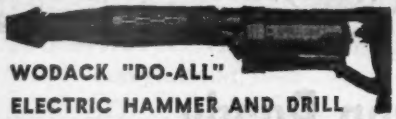

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ELECTRIC HAMMER AND DRILL

Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1¾" dia., metal ⅝". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for bulletin.

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SODER-FLUX
Underwriters' Approved
L. B. ALLEN CO., INC.
6715 Bryn Mawr Ave. Chicago 31 ,Ill.

ELECTRIC HEATING APPLIANCE ELEMENTS REPAIRED. NICHROCITE PASTE IS USED.

To get at otherwise inaccessible places, in toasters, irons, overhead elements in ovens, furnaces, etc. Simply overlap ends apply Nichrocite Paste and turn on current. Used by large utility companies. Generous trial order $1.00, 4 oz., $2.50, 1 pound $8.00.

ADVANCE CO. Box 861 Minneapolis, Minn.

This
WHERE TO BUY
Section
supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation, maintenance and service. Make a habit of checking this page, each issue.

DEPARTMENTAL STAFF
ELECTRICAL CONTRACTING

P.A. Integrates Plant Operations

[FROM PAGE 53]

times, pilot lamps on the main control board, indicate that they are "on the air".

As a precautionary measure against possible power failure auxiliary power supplies protect a-c and d-c against breakdown from all causes and interlocking automatic relays signal the trouble by lights and sound.

The 400 cycle "stop" and "go back to work" tone signals are automatically controlled by an I.B.M. program clock and are created by a special oscillator. At present, only one tone is used but a new six-tone, dual channel oscillator, which can be either manually or automatically controlled by relays is being installed. With this it will be possible to vary the six tones to any frequency desired within the audio range, from 30 to 15,000 cycles, with a flat response plus or minus 2-DB. The difference in tones will enable the plant to notify departments with overlapping lunch periods when to stop or go back to work.

More than 200,000 feet of two conductor number 18 gauge, twisted pair, copper shielded wire, was used to install the system. Shielded wire was employed to preclude the possibility of crosstalk sometimes caused by running unshielded high level lines over great distances.

Normally, news and music broadcasts are presented to each shift at the lunch periods and the system is, of course, in 24-hour use by the plant protection department. In addition to straight war broadcasts from time to time, war heroes and other personalities are interviewed and address employees over the system.

LIGHTING DESIGNS in the postwar era is a favorite topic of two Detroit engineers Carl Schroeder (left), electrical engineer, Giffels & Vallet, Inc., architects and engineers; and Don Trefry, illuminating engineer, Detroit Edison Company.

Fluorescent Maintenance Contracts

[FROM PAGE 61]

There are two kinds of basic contracts now being used. In one the contractor agrees to provide *partial* maintenance by keeping the customer's fixtures in good electrical operating condition. He agrees to replace lamps, starters, ballasts or other parts of the fixture when he is notified by the customer that service is needed. The contractor insists that he be notified promptly, and the customer agrees he will not attempt to make repairs. The contractor does not agree to clean fixtures or to make regular service calls. Charges for this type of maintenance service are usually based on a fixed rate per lamp per month, ranging from 16 cents to 20 cents per lamp. The total charge is determined by multiplying the unit charge by the total number of lamps in service. A typical commercial installation illustrating this basis of contract charges is as follows:

Number of Fixtures	Number of Lamps	Lamp Wattage
20	4	40
10	2	40
5	1	40
8	1	40
6	2	20

In this particular installation, fixtures used for other than general lighting include five show case fixtures and 14 window fixtures. The total number of lamps is 125 and, assuming the monthly maintenance charge is 16 cents per lamp, the monthly billing for service will total $20.00.

In a contract of this sort, the electrical contractor will base his charges on average experience. If lamps burn rated life or longer and there is no unusual accessory service he will profit. If, however, an occasional installation is unusually troublesome, and therefore costly, he may not make a profit on the particular installation. This is usually the exception to the rule. The law of averages will assure an overall profit since the majority of lighting installations will operate normally and will not involve unusual risk or high costs.

Unnecessary service calls may be reduced or eliminated by scheduling calls to remove badly blackened lamps and voluntarily inspecting fixtures when other service calls are made in the vicinity. The risk of loss accounts may also be minimized by expanding the service to cover a diversity of types of installations. Another way to re-

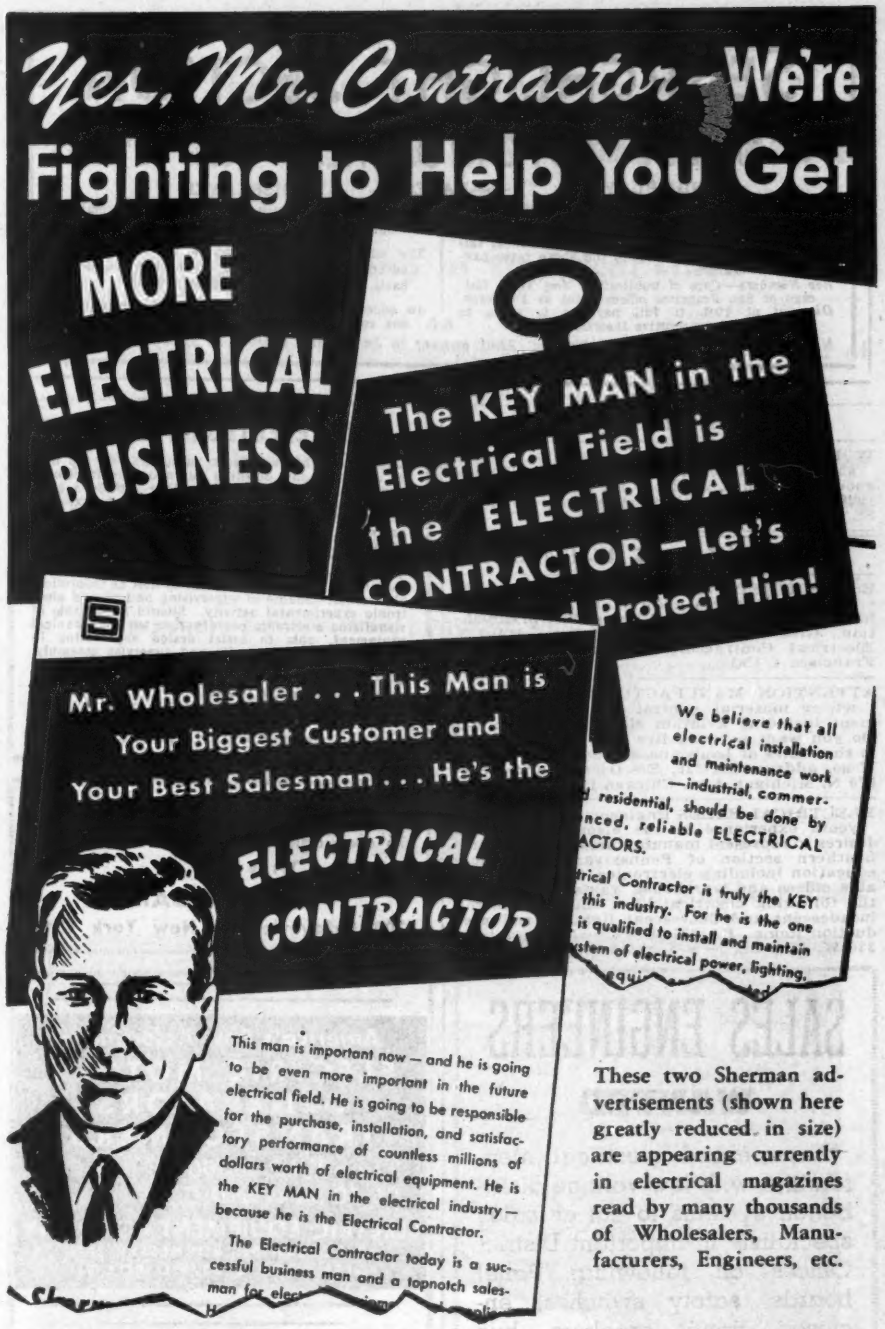
duce calls for lamp replacement is to make group replacements of all lamps in each fixture.

Salesmen promoting lighting maintenance service should carefully inspect the condition of each fixture and make a note of its location before entering into a contract with the customer. In some instances, it may be advisable to require that fixtures are reconditioned before the contract becomes effective, in order to eliminate the possibility of immediate loss on service calls. Lamps in inaccessible locations such as show cases and windows sometimes cannot be replaced conveniently at the time of failure. Fixtures including these lamps should be equipped with cut-out type starters, so that starters and ballasts will not be damaged between the time of lamp failure and an opportune time for replacement.

Another basic type of contract is used to cover *complete* maintenance service. In it, the contractor agrees to keep fixtures clean in addition to *regularly* maintaining the electrical condition of each fixture. The contract covers regular group replacement of both lamps and starters and regular maintenance of all other electrical components. The customer is charged list prices for replacement lamps and replacement starters. Charges for fixture cleaning are based on local labor rates. Additional service requirements, including the servicing or replacement of ballasts and sockets, is usually covered by an extra charge determined by standard prices of material and local labor rates. These additional service costs are not written into the contract, but the contract stipulates additional service shall be performed by the electrical contractor.

Lamps and starters are replaced in groups to assure maximum reliability and predictability of lighting service. Lamp replacements are now generally considered economical after 1500 hours of service, although recent lamp ratings indicate that in some installations considerably longer useful life may be expected. For this reason, the contractor should consider both the ratings of lamps and their actual operating conditions before determining their span of useful life in a given installation. Service calls may be reduced, in many instances, by scheduling fixture cleaning and lamp replacements at the same time. The frequency of fixture cleaning will, of course, be determined by conditions at each location. In clean air-conditioned shops reflectors and diffusing mediums will

[Continued on page 170]


Yes, Mr. Contractor—We're Fighting to Help You Get
MORE ELECTRICAL BUSINESS
The KEY MAN in the Electrical Field is the ELECTRICAL CONTRACTOR—Let's Protect Him!
Mr. Wholesaler . . . This Man is Your Biggest Customer and Your Best Salesman . . . He's the
ELECTRICAL CONTRACTOR
This man is important now — and he is going to be even more important in the future electrical field. He is going to be responsible for the purchase, installation, and satisfactory performance of countless millions of dollars worth of electrical equipment. He is the KEY MAN in the electrical industry — because he is the Electrical Contractor.
The Electrical Contractor today is a successful business man and a topnotch sales-
We believe that all electrical installation and maintenance work —industrial, commer-
residential, should be done by
nced, reliable ELECTRICAL
ACTORS.
trical Contractor is truly the KEY
this industry. For he is the one
is qualified to install and maintain
stem of electrical power, lighting,

These two Sherman advertisements (shown here greatly reduced in size) are appearing currently in electrical magazines read by many thousands of Wholesalers, Manufacturers, Engineers, etc.

Electrical Contractors deserve the support of wholesalers, manufacturers, and everyone else in this industry. The reputable, experienced Contractor *should* get more electrical business, and *we are going to help him get it!*

The two advertisements, shown in greatly reduced size above, are just part of this powerful campaign that Sherman has started, to build the prestige of the Electrical Contractor.

We want to include YOUR ideas and experience in future advertisements similar to these. Take a few minutes and write us your suggestions for helping the contractor to get more business.

H. B. SHERMAN MFG. CO., Battle Creek, Mich.

Sherman ELECTRICAL SPECIALTIES

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT : BUSINESS : "OPPORTUNITIES" : EQUIPMENT : USED OR RESALE

UNDISPLAYED —RATES— DISPLAYED

(Not available for equipment advertising)

10 CENTS A WORD. MINIMUM CHARGE $2.00

Positions Wanted (full or part time individual salaried employment only), ½ the above rates payable in advance.

Box Numbers—Care of publication New York, Chicago or San Francisco offices count as 10 words.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Individual Spaces with border rules for prominent display of advertisements.

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page. E.C.

New advertisements received by Dec. 22nd appear in Jan. issue, subject to space limitations.

POSITION VACANT

WORKING FOREMAN, for electrical repair shop doing large and small work of all types, good opportunity, good pay for right man. Box 1029, Mitchell Advertising Agency, 1 Beekman St., New York City.

REPRESENTATIVES AVAILABLE

ESTABLISHED SALES agency in Pacific Northwest desires additional electrical lines have own warehouse and live selling organization. Give complete post-war plans. RA-323, Electrical Contracting, 68 Post Street, San Francisco 4, Cal.

ATTENTION: MANUFACTURERS of electrical wiring material, control devices and equipment including aviation electrical equipment. Do you want a young live wire representative in the states of Louisiana and adjacent states? If so, address RA-325, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL SALES Engineer: age 44, has 25 years experience in the electrical business desires to represent manufactures in the Central Southern section of Pennsylvania, electrical education including electronics, and has available offices and warehouse wants to represent the following electrical lines, motors, control, incadescent and fluorescent lighting and production items. RA-327, Electrical Contracting, 330 W. 42nd St., New York 18, N. Y.

SALES ENGINEERS WANTED

Experienced electrical men, familiar with low voltage distribution systems to act as sales specialists in important District Offices on following: Panel boards, safety switches, enclosed circuit breakers, bus duct and load centers. Men accepted to receive full training at factory at company's expense before assignment. Write to Supervisor, Technical Employment, 306 Fourth Avenue, Pittsburgh, Pennsylvania, for application form.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

PITTSBURGH 30, PA.

SALES MANAGER

For well established concern operating wholesale electrical supply distributing business. Must have had actual experience in this field.

SW-226, Electrical Contracting
330 West 42nd St., New York 18, N. Y.

CHIEF ELECTRONIC ENGINEER

Company with seven years background in the field of designing and building automatic photo-electric equipment has Postwar plans that include a great opportunity for an individual who will be expected to handle developmental activity of electronic department. He will supervise electronic department personnel, coordinate activity of plant and field engineers, assume responsibility of entire department as executive head. Applicant should be thoroughly trained in practical as well as theoretical electronics, capable of supervising optical and electronic experimental activity. Should be capable of visualizing electronic coordination with mechanical equipment, able to assist design engineering in development of new units and supervise assembly, wiring, and eventual incorporation of units in completed machines; supervise installation of our machines in customers' plants.

P-328, Electrical Contracting
520 North Michigan Ave., Chicago 11, Ill.

WANTED

75 drop annunciator for Hotel. In good condition. Write

C. E. MELGARD
203 Lafayette St., New York City

America's Best Assortment

ELECTRIC MOTORS
GENERATORS
TRANSFORMERS

from 1 H.P. to 1000 H.P. A.C. 25-50-60 cycle D.C., all voltages

ELECTRIC EQUIPMENT COMPANY
63 CURLEW ST., ROCHESTER, N.Y.
GLENWOOD 6783, P.O. BOX 51

UNIVERSAL TOOLS!

8 Piece Set: CEETEE Pliers, VISEGRIPS, CHANNELLOCK Pliers, DIAGONAL Cutters, NEEDLE NOSE Pliers, Crescent Wrench, HAMMER & SCREWDRIVER $14.85. Remit with order. Other Tools you need? We'll Ship COD Promptly. Keep our name on file for future reference.

DEALERS TOOL SUPPLY
1527 Grand Ave. EC Kansas City, Mo.
"We have it—Can get—Or it isn't made"

IF THERE IS

Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

SEARCHLIGHT SECTION

Fluorescent Maintenance Contracts

[FROM PAGE 169]

not need to be cleaned as often as those in dusty, open air shops and some industrial applications. The type of fixtures in use and the number of hours a day lamps are normally burned will be factors the contractor will consider before committing himself to a contract price.

Assuming that fixtures operate about 3000 hours a year, and cleaning is necessary twice a year, the following figures suggest how charges may be computed when lamps are changed after 1500 hours of operation:

25 open two-lamp 40 watt fixtures	50 lamps
2 complete sets of lamps yearly	100 lamps
1 complete set of starters per year	50 starters
2 cleanings per fixture per year	50 cleanings
lamp cost, 100 x 95¢.....	$95.00
starter cost, 50 x 36¢....	18.00
cleaning cost, 50 x 75¢...	37.50
yearly maintenance cost..	$150.50
monthly maintenance cost	12.55

Approximate charges for additional service performed by the contractor are suggested as follows:

cleaning commercial type 4 lamp shielded fixture...	$1.50
cleaning commercial type 4 lamp open fixture.....	1.00
cleaning commercial type 2 lamp shielded fixture...	1.25
cleaning commercial type 2 lamp open fixture.....	.75
replacing ballasts, labor and material	9.50
replacing sockets, labor and material	1.25

Selling the Service

Fluorescent lamp maintenance is a new service and requires direct personal selling. This effort may be amplified with a direct mail followup and by local advertising. Contractors can establish themselves in this new and profitable business by first calling on their old customers. Very often these customers are represented by the restaurants in which they eat, the local grocery and meat market and other retail stores where they regularly trade. If a full time salaried salesman is hired, it should be borne in mind that he will be selling a new idea and creating new business, the effect of which will be cumulative. His first

few months of salary should therefore be considered as an investment . . . in the profitable return which will extend over a period of years.

Some contractors prefer to hire salesmen on a commission basis, so that their remuneration will be governed by a percentage of several years billing. For example, a salesman signs up five contracts having a monthly billing value of $10 each. The contractor figures the salesman has, in one week, created business worth $600 a year, or $1200 over a two year period, and $1800 over a three year period. Therefore he bases the salesman's commission on a percentage of the total billing, depending on the length of time his contract covers. When contracts are non-cancellable the contractor is protected. He assumes no credit risk, since billings and payments are made in advance.

Lighting maintenance employees should be selected just as carefully as the contractor would select any other employee. Those with special aptitudes for service work are the most desirable and should be carefully trained in the contractor's shop before calling on customers.

Conclusion

Lighting maintenance service is similar to insurance. It serves to assure the maximum amount of available useful light from fluorescent fixtures, not only when they are new, but day in and day out for the life of the contract. Planned fluorescent lighting service gives the user what he is really buying . . . the greatest amount of useful light at the lowest possible cost, without needless interruptions or gradual dimunition of quantity.

Besides giving the electrical contractor a new and profitable department of activity, planned fluorescent lighting maintenance can be the logical source of other sales benefits. Regular contacts with new and old customers can lead to increased sales of new lighting and other electrical equipment and service. The continuing revenue from maintenance service also provides a profit source of high stability and provides a basis for regular year-round employment.

In short, fluorescent lighting maintenance is the third and newest phase in the fluorescent lighting business. Only with planned maintenance service can all the benefits of modern manufacture and installation be fully, economically, and profitably realized. It is a new opportunity for increased sales and profits that can begin now and grow during the postwar period.

Announcing

formation of the firm of

DWYER & JOHNSON

Sales Representatives
Specializing in Electrical Lines

J. Emmet Dwyer—For past 25 years President and owner of Chicago Electrical Supply Company, recently sold.

Harold E. Johnson—Former general manager of Chicago defense plant. Twenty years as sales representative for well known manufacturers.

The partners have eleven hundred well established personal accounts in the electrical industry. Interested in securing three or four lines for electrical wholesalers, and leading industrial accounts.

OFFICES

600 W. Jackson Blvd. · Chicago 6 · Andover 3966

THERE ARE HUNDREDS
OF DIFFERENT TYPES OF
UNIVERSALLY ADJUSTABLE
SWIVELIER
Pat'd and Pats. Pending—Reg. U. S. Pat. Office
LIGHTING UNITS
FROM WHICH TO FIND THE ONE THAT YOU NEED
TO ADJUST THE LIGHT TO WHERE YOU WANT IT
Send for free catalogs:
SWIVELS AT ANY ANGLE
RELIANCE DEVICES Co. Inc.
Dept. B44, 30 Irving Pl.
New York 3, N. Y.

Wanted

ENGINEERS

Radio
Chemical
* Electrical
Electronic
* Mechanical
Metallurgical
* Factory Planning
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R. L. D., EMPLOYMENT DEPT.

Western Electric Co.

100 CENTRAL AV., KEARNY, N.J.

*Also: C. A. L.
Locust St., Haverhill, Mass.
Applicants must comply with WMC regulations

DOUBLE OPPORTUNITIES

for

SALES AND PROFIT

SELLING AND INSTALLING

AUTOMATIC POULTRY TIME SWITCHES

for

LIGHTING
POULTRY
HOUSES

Cash in on this profitable market! Every poultry raiser now knows that ***LIGHTS INCREASE PRODUCTION AND PROFIT.*** They all want these Poultry Time Switches. Sell them! Install them! The season's short. ACT NOW!

FOUR MODELS
$12.00 to $18.00

With and without "Dimmer Circuit"
All-Electric and Manually-wound

Write for Information

AUTOMATIC ELECTRIC MFG. CO.
MANKATO, MINNESOTA

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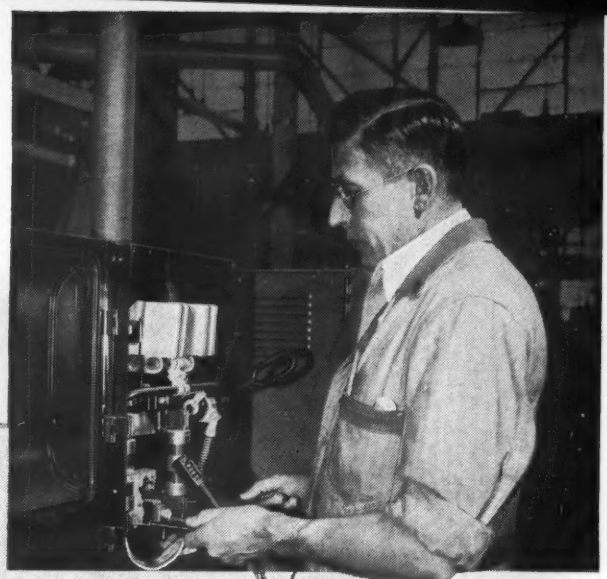
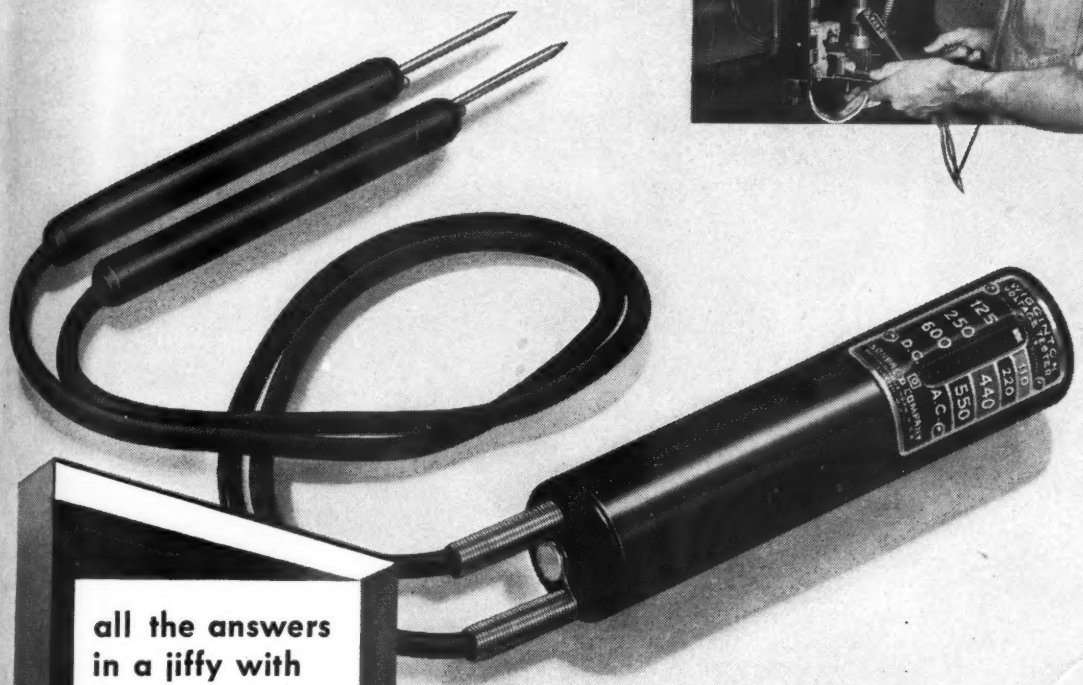
★ **These companies have included Briefalogs, containing additional buying information on their products, in the 1944 edition of the Electrical Buyers' Reference.**

"is this a live circuit?"
"which fuse is blown?"
"A.C. or D.C.?"
"what voltage?"





all the answers in a jiffy with this pocket-sized and practically indestructible

SQUARE D *Voltage Tester*

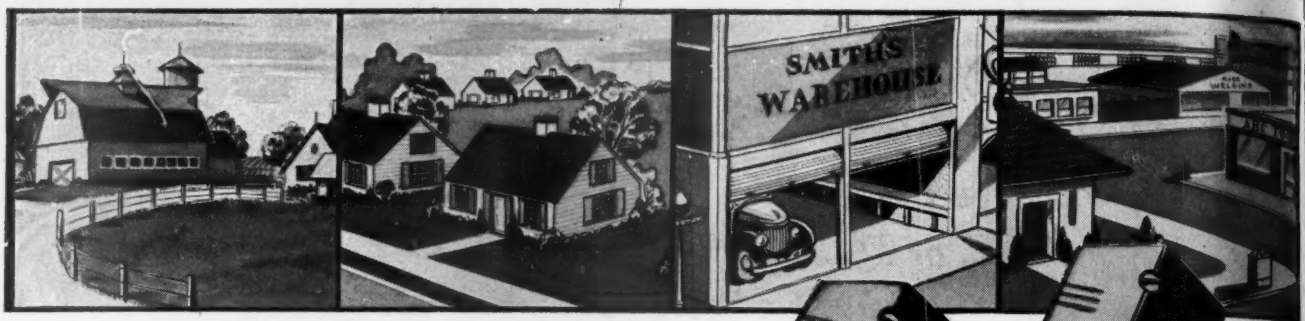
• Ask your Square D distributor about this voltage tester. See if it isn't one of those handy stand-bys you'll want to have.

Notice the convenience and safety with which you test voltages and types of current without the use of lamps. Simply establish contact and the indicator shows the voltage. Each voltage is shown by a different colored band for easy, accurate reading. A.C. is distinguished from D.C. by vibration of the indicator. Sharp prongs permit piercing insulation, when necessary, without damage.

You'll get years of real service out of this tester—it's built to stand the gaff. See your distributor or write us direct for descriptive folder.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES



MONCOR *Surface Wiring* DEVICES

FOR QUICK NEW WIRING OR WIRING EXTENSIONS

You'll like to use these good-looking, sturdy surface devices. They can be installed quickly and easily with BraidX or BX. They meet all requirements on every surface wiring job whether cables are hidden or exposed. Use them for new surface wiring or for wiring extensions or additions. They are approved by the Underwriters'.

Moncor Surface Wiring Devices are made of brown Textolite, retain their color and resist breakage. All required devices are available: single pole switches, 3-way switches, convenience outlets, lampholders with or without pull chains and junction boxes and rosettes. They can be end connected or side connected (cleat wiring) for surface wiring or back connected for concealed wiring.

FOR FURTHER INFORMATION on Moncor Surface Wiring Devices, other G-E wiring devices or G-E conduits or wires, see the nearest G-E Merchandise Distributor or write to Section CDW-1241-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

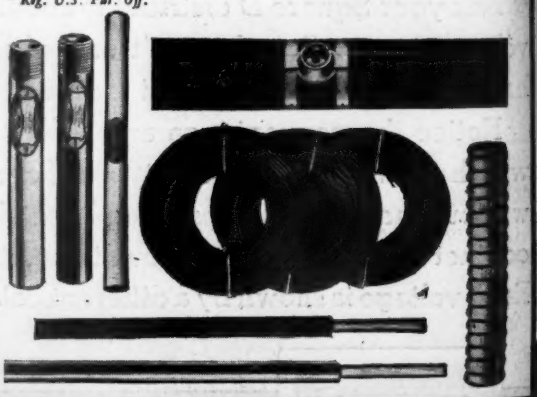
BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All-Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news every weekday 6:45 P.M. EWT, CBS.

G-E CONDUIT AND BUILDING WIRES

There are G-E conduits and building wires for every purpose: G-E White zinc-covered rigid conduit, G-E Black enamelled rigid conduit, EMT, flexible conduit, Fiberduct and various building wires including Types SN and SNW small diameter, thermo-plastic insulated Flamenol* Building Wire.

** Reg. U.S. Pat. Off.*



ADEQUATE WIRING TAKES FIRST RANK IMPORTANCE

ADEQUATE WIRING — THE KEY TO THE HOME OF TOMORROW — SERVES AND SAVES

William A. Ritt, secretary-manager North Central Electrical Industries, Minneapolis, Minn. says, "Because the degree to which electrical appliances, equipment and control are employed will largely distinguish postwar from prewar homes, adequate wiring must take first rank importance in all future home building plans."

GENERAL ELECTRIC